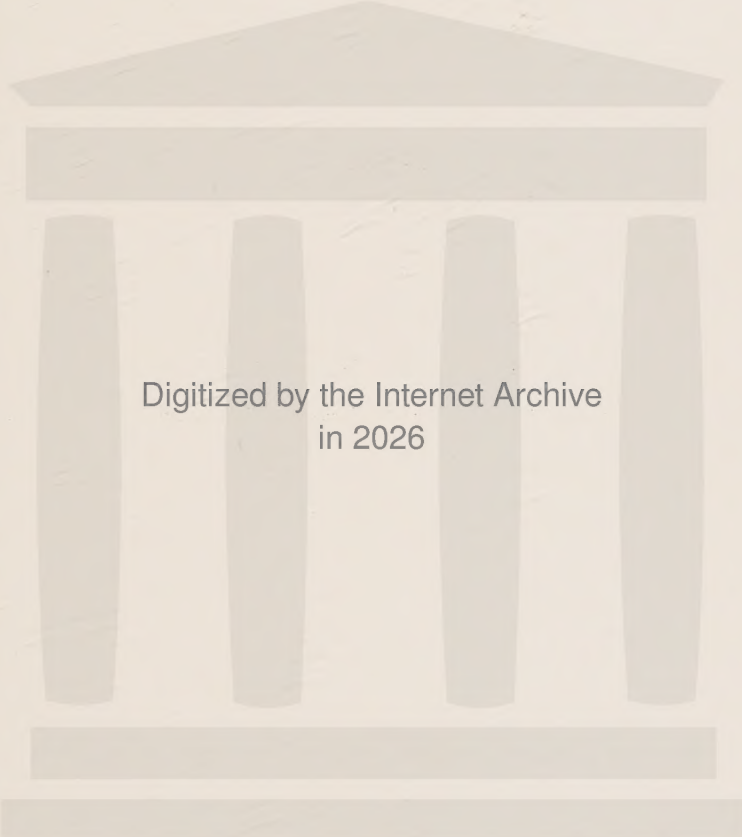




Digitized by the Internet Archive
in 2026

NATURE BOOKS *edited by*
HARTLEY H. T. JACKSON

ANIMAL LIFE OF YELLOWSTONE NATIONAL PARK—*Vernon Bailey*

DENIZENS OF THE MOUNTAINS—*Edmund C. Jaeger*

DEER AT NIGHT IN THE NORTH WOODS—*Tappan Gregory*

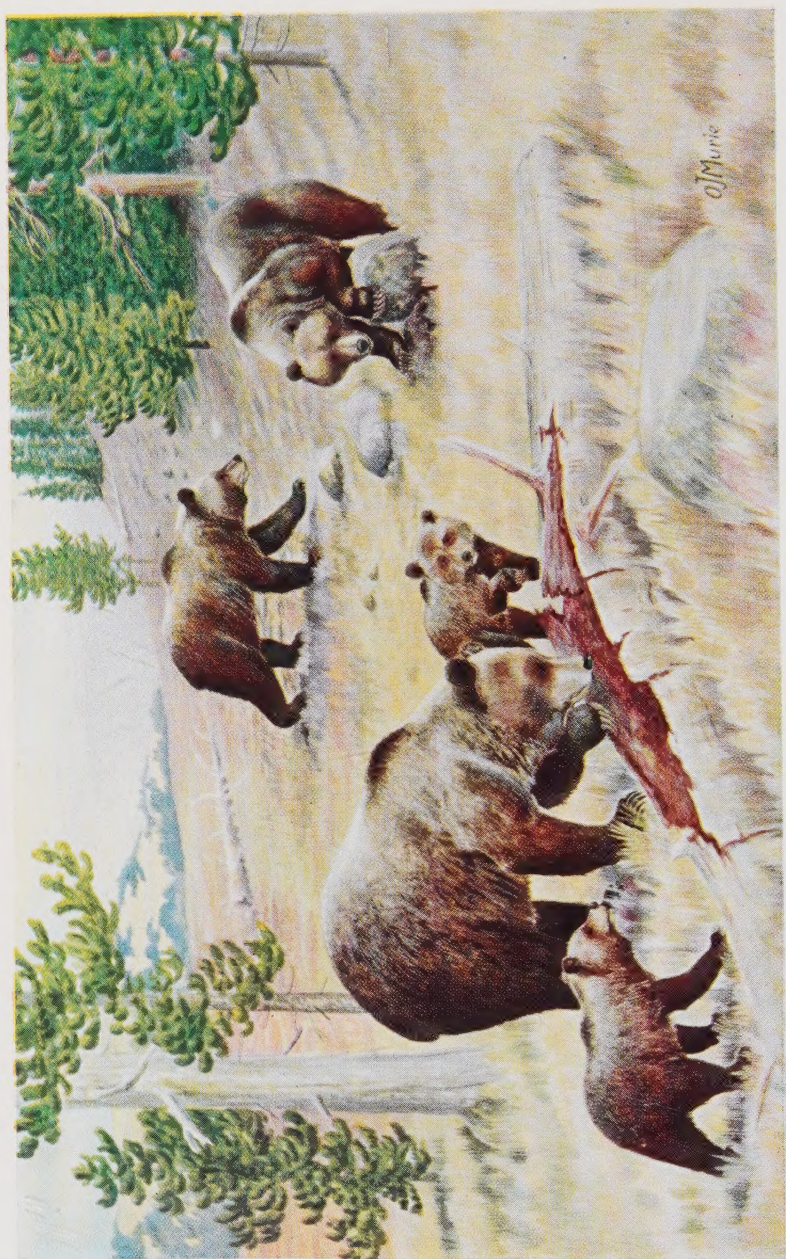
INSECTS ABOUT HOME—*James G. Needham*

ENVIRONMENT AND LIFE—*A. S. Pearse*

COMMON PESTS—*R. W. Doane*

ANIMAL LIFE OF
YELLOWSTONE
NATIONAL PARK

LIBRARY
LOS ANGELES COUNTY MUSEUM
EXPOSITION PARK
Los Angeles 7, California



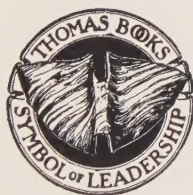
Painting by Olaus J. Murie

FIG. 1. THE BIG GRIZZLY BEARS OF YELLOWSTONE PARK

ANIMAL LIFE OF YELLOWSTONE NATIONAL PARK

BY
VERNON BAILEY

CHIEF FIELD NATURALIST
UNITED STATES BIOLOGICAL SURVEY



CHARLES C THOMAS · PUBLISHER
SPRINGFIELD · ILLINOIS BALTIMORE · MARYLAND

1930

COPYRIGHT, 1930, BY
CHARLES C. THOMAS

LIBRARY
LOS ANGELES COUNTY MUSEUM
EXPOSITION PARK
Los Angeles 7, California

FIRST PUBLISHED, 1930
MANUFACTURED IN THE UNITED STATES OF AMERICA

ANIMAL LIFE OF
YELLOWSTONE
NATIONAL PARK

CONTENTS

List of Illustrations.....	xi
----------------------------	----

CHAPTER I

Introduction and Acknowledgments.....	3
---------------------------------------	---

CHAPTER II

Life Zones of Yellowstone Park.....	9
-------------------------------------	---

CHAPTER III

Mammals of Yellowstone Park.....	16
----------------------------------	----

CHAPTER IV

Birds of Yellowstone Park.....	188
--------------------------------	-----

CHAPTER V

Fish, Reptiles and Amphibians of Yellowstone Park.....	229
--	-----

CHAPTER VI

Invertebrates of Yellowstone Park.....	231
--	-----

Index	233
-------------	-----

ILLUSTRATIONS

FIG. 1.	The Big Grizzly Bears of Yellowstone Park . . .	<i>Frontispiece</i> (In color, by O. J. Murie)
INSERT.	Life Zone Map of Yellowstone Park Region . .	<i>Facing page 9</i> (In color)
FIG. 2.	Part of the Tame Herd of Buffaloes	19
FIG. 3.	Buffalo Cows and Calves in the Tame Herd	20
FIG. 4.	The Tame Herd in Their Winter Pasture	22
FIG. 5.	Old Bulls Are Inclined to Be Morose and Solitary . . .	22
FIG. 6.	A Bunch of Bighorn Rams	26
FIG. 7.	Antelopes in Spring	31
FIG. 8.	Antelopes in Alfalfa Field	33
FIG. 9.	Young Antelope Hiding	34
FIG. 10.	Bull and Cow Moose in Upper Yellowstone Valley . .	38
FIG. 11.	Bull Moose	40
FIG. 12.	Elk Feeding on Hay Provided for Them in Winter . . .	44
FIG. 13.	Elk in Winter, Feeding on Alfalfa Hay	46
FIG. 14.	Elk on Their Winter Range in Jackson Hole	48
FIG. 15.	Typical Elk Winter Range on Windswept Summit of Specimen Ridge	49
FIG. 16.	Elk Trailing through Deep Snow in Spring	50
FIG. 17.	Elk Calf About Two Days Old	51
FIG. 18.	Elk Calf About Two Days Old	51
FIG. 19.	Willows Browsed by Elk in Winter	55
FIG. 20.	Willows in Summer Showing Effect of Winter Browsing by Elk	57
FIG. 21.	Fence of Shed Elk Horns around Old Yancey Stage Station	58

	<i>Page</i>
FIG. 22. Mule Deer in Winter.....	62
FIG. 23. Mule Deer Reaching for Apple in Open Window..	64
FIG. 24. White-Tailed and Mule Deer Does in Spring.....	66
FIG. 25. White-Tailed Deer in Early Winter.....	68
FIG. 26. Pine Squirrel Feeding in Spruce Tree.....	72
FIG. 27. Twenty Bushels of Old Cone Scales under Spruce Trees where Pine Squirrels Sit to Feed.....	74
FIG. 28. Winter Nest of Pine Squirrel.....	75
FIG. 29. Cones and Seed of <i>Pinus albicaulis</i> , Eaten by a Pine Squirrel and Grizzly Bear.....	76
FIG. 30. The Little Wasatch Chipmunk.....	81
FIG. 31. Gray-Mantled Ground Squirrel.....	84
FIG. 32. Uinta Ground Squirrel.....	87
FIG. 33. Woodchuck at Yellowstone Canyon.....	92
FIG. 34. Woodchuck in Bitterroot Valley.....	94
FIG. 35. Wood Rat House in Cleft of Rock Wall.....	97
FIG. 36. Bushy-Tailed Wood Rat.....	99
FIG. 37. Muskrat House	109
FIG. 38. Muskrat	110
FIG. 39. Beaver Dam, House, and Pond.....	113
FIG. 40. Yellowstone Beavers	114
FIG. 41. A Thirty-three-pound Porcupine.....	116
FIG. 42. Jumping Mouse	118
FIG. 43. Cony in the Retaining Wall of the Road through Gold- en Gate	122
FIG. 44. Cony Hay-Stack under Rocks.....	123
FIG. 45. Snowshoe Rabbit in Winter Coat.....	126
FIG. 46. Jack Rabbits in Gray Coat.....	128

	<i>Page</i>
FIG. 47. Mountain Lion at Bay in Tree.....	130
FIG. 48. Bobcat	133
FIG. 49. Three Wolves Killed by Stevenson and Black, and a Breeding Den in Cavern under Rock, from which Six Young Wolves Were Taken.....	134
FIG. 50. Coyote Hunting Mice.....	138
FIG. 51. Coyote Hunting Mice.....	139
FIG. 52. Otters	143
FIG. 53. Marten Photographed at Ten and Fifteen Feet up a Tree	146
FIG. 54. Engelmann Spruce and Lodgepole Pine Stripped of the Lower Bark by Bears.....	154
FIG. 55. Large Black Bear in Woods.....	156
FIG. 56. Black Bears at Garbage.....	160
FIG. 57. Black Bears Often Remain in a Comfortable Tree Top until the Coast is Clear Below.....	164
FIG. 58. Long-Eared Bat.....	180
FIG. 59. Long-Eared Bat.....	181
FIG. 60. Silver-Haired Bat.....	185
FIG. 61. Large Brown Bat.....	186
FIG. 62. A Flock of Contented Canada Geese.....	189
FIG. 63. Trumpeter Swans.....	189
FIG. 64. Male Richardson's Grouse Hooting.....	193
FIG. 65. Male Richardson's Grouse Hooting.....	194
FIG. 66. Gray Ruffed Grouse.....	195
FIG. 67. Columbia Sharp-Tailed Grouse.....	196
FIG. 68. Sage Grouse.....	197
FIG. 69. Bald Eagle..... <i>(In color, by Robert Ridgway)</i>	199
FIG. 70. The Three Rosy Finches of Yellowstone Park.. <i>(In color, by O. J. Murie)</i>	208

CHAPTER I

INTRODUCTION

THE WONDERFUL GEOLOGIC and scenic features of the region now included in Yellowstone National Park have, from their first discovery, excited great interest and have been wisely guarded and made accessible to pleasure seekers and students of all civilized countries. But not until recent years have the interest and value of the animal life of the park been fully realized. As large game animals have disappeared over much of the country and some have been threatened with extermination, the importance of the area, not only as one of the greatest zoological parks of the world but as a refuge for vanishing species and a source from which other parks and depleted game regions may be restocked, has become more and more apparent. In few places have the primitive conditions necessary for wild animal life been so well preserved as here, and with this great area under control it should be possible not only to maintain but to increase the abundance of desirable species. Many of the small as well as the large mammals are of great interest and some are of exceptional value, while a few are capable of doing serious mischief or of destroying more important animals. The control of the injurious as well as the preservation of the desirable species depends upon a thorough knowledge of their lives and habits.

A great part of the timid wild life of the land is as strange to most of us as if it belonged to another world, and even the names of many of our common animals appear only in Greek and Latin combinations that mean nothing to the majority of the people. Dogs and cats and guns are familiar to all, but the tendency to destroy is gradually giving way to the desire to

know and understand the lives of the wild creatures about us. The flowers have color and graceful form and fragrance, the birds have beauty and song, but the higher class of animal life, to which we belong, offers a greater field of interest in the study of habits, intelligence, and adaptation to conditions of life more nearly akin to our own.

The struggle for existence has rendered many of the wild animals timid and retiring, forcing them to take up residence in obscure corners, under the surface of the ground, in the water, or in tree tops, and to seek their food and carry on their activities largely under cover or at night. Others, through strength and skill and structural advantages, have become ferocious and destructive to the weaker, less aggressive forms upon which they prey, and still others have developed great speed, acute senses, or habits of life that partially protect them from their enemies. All have more or less flexibility of nature, enabling them to adapt their habits to changing environment, as is shown in many ways, and in none more pleasantly than in giving their confidence to man on sufficient guarantee of friendly intentions. Years of unusual freedom from being hunted by man or chased by dogs or cats is resulting in a change from timidity to confidence in both large and small residents of the park. This is especially noticeable in the deer, antelope, and mountain sheep, and in the bears, otter, marten, beaver, woodchucks, rabbits, chipmunks, tree squirrels, and some of the ground squirrels. In many cases these friendly relations can be cultivated and increased so that many of the secrets of wild life can be obtained here as in few other places. For students and nature lovers the park offers a rich field for animal study.

At the present time there is no other area of equal size in the United States, or even North America, where the native animal life is so abundant and unafraid as in Yellowstone National Park. Some tourists whose experience has been limited to good roads, busses, and hotels may question this statement, but all who know the trails, the back-ways, the ranger stations, and

snowshoe cabins will realize the fact. Even along the good roads and around the large comfortable hotels there is a wealth of animal life, generally increasing in abundance and improving in manners.

Since the restrictions on firearms, traps, cats, and dogs in the park and the long continued efforts of park officials to teach the visitors proper regard for animal life and happiness there has been a steady growth of mutual understanding between man and beast. This is well shown by the bears that sit respectfully beside the road and wait until invited to the open door of an automobile for some dainty, the elk and deer that often stand near the road to let the cars pass or in winter come confidently to back doors of ranger stations, hotels, or occupied houses and stamp on the doorstep to let one know they would appreciate a bite to eat, or the big woodchucks at the canyon of the Yellowstone that come waddling up to you in hopes of receiving crackers. Even the timid jack rabbits at Mammoth, without the lure of food, will sit on a close-cut lawn nibbling clover while you come to six feet for a snapshot with the camera, and the squirrels and chipmunks and even some of the birds greet visitors with friendly confidence and good will.

A most gratifying increase in the numbers of large and small game animals in the park in recent years is a matter of reliable record and gives the clue that is needed to methods of intelligent control of the wild life of such areas. It now seems possible, by using our fund of accumulated knowledge and practical means of control, to predetermine the desired abundance of any species and then to maintain that abundance. Also it is becoming comparatively easy to regulate the local distribution of most animals so as to gain for each the greatest advantage of food supply, suitable cover, and favorable living conditions.

Practically all of the animal life of the park is native to the area, and there is a strong feeling against the introduction of any exotic forms of either animals or plants, although weeds will creep in along the roads and the English sparrow has penetrated

as far as Gardiner and Mammoth Hot Springs. Several forms of trout have been brought in with which to stock the unoccupied streams and maintain the good fishing. All domestic stock has been barred from the park except the necessary saddle and pack horses for official and public use.

Thus as far as possible the wild life has been preserved in a natural condition, free from the terror and destruction of outside areas. Every effort has been made to obtain the coöperation of the visiting public in the progressive policy that seeks the welfare of the native animals. This in itself has been of great educational value in building up a sound spirit of conservation among the thousands of representative citizens coming from all over the country.

The greater educational features of the wild life of the park are now beginning to be realized and appreciated to the extent of providing competent park naturalists, ranger naturalists, and nature guides to enable more of the visitors to understand what they see and to carry home reliable information. To the zoölogist or botanist the parks are more and more coming to be graduate schools and research laboratories of the highest order. In fact they will soon be among the few places where undisturbed native wild life can be found, or the approximately natural interrelation of species studied.

The material here presented is based on many trips by myself and others to the park in the course of Biological Survey work that is being carried on over the whole country, and on special trips for study of the elk herds and other game animals in both winter and summer, as well as on one most delightful walking trip around the trails of the park with the Sierra Club party of 1926. It is not offered as in any sense a complete study of the animal life of the region. It is merely intended to put on record my contribution toward the fuller study of life to be carried on here in the future, to record some passing phases of animal interrelations and possibly to suggest lines of future study most urgently requiring long and careful observation.

One of the early trips to the park was by C. Hart Merriam in 1872, as naturalist of the Hayden Survey, and his brief report constitutes an important check on the animal life at that time. Ernest Thompson Seton (*Recreation*, May, 1898, pp. 365-371) also has reported on the mammals.

My own notes are from trips in the park in 1894, 1909, 1915, 1916, 1917, and 1926, covering all seasons except midwinter. In 1894 I was accompanied by Basil Hicks Dutcher.

Some notes are also drawn from reports on file in the Biological Survey by Merritt Cary, Alexander Wetmore, and Clarence Birdseye in 1910, and numerous field reports as well as published reports by M. P. Skinner, for many years park naturalist. More recent notes are from park naturalists and rangers issued monthly in *Yellowstone Nature Notes*.

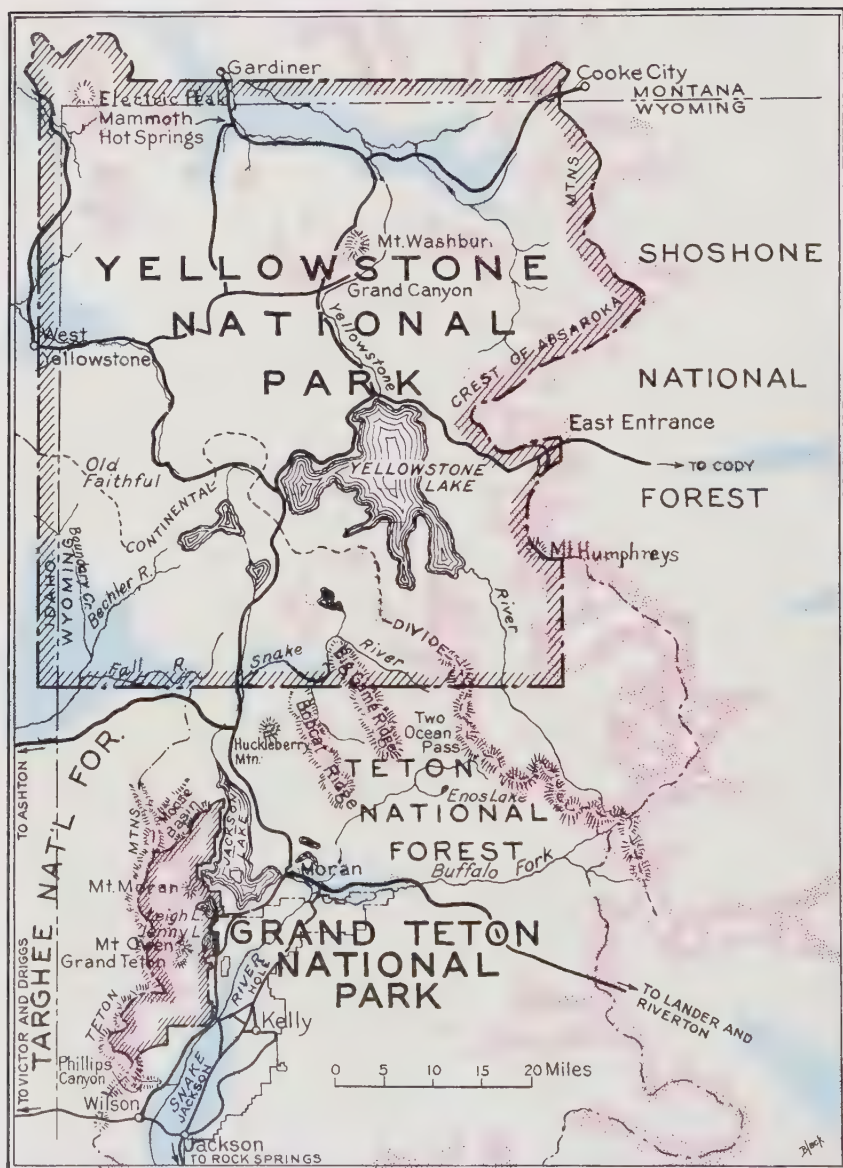
The works of other writers have not been largely drawn upon because it is not yet time to assemble the parts for a complete whole. There is sufficient material available for only a fair beginning; the published reports are carefully listed in the *General Information Circulars* of the park, at least all except some of the more recent publications by Skinner, Heller, and Warren.

The high standards of educational service set by the national park administration under the late Stephen T. Mather and continued under his successor, Horace M. Albright, encouraged and supported by such organizations as the Carnegie Institution of Washington, the National Academy of Sciences, the National Research Council, and the National Parks Association, are being recognized the world over as inspirational in character. Both the educational and inspirational value, however, must come through intelligent personal contact and observation. The published records are not an end but a means to a much larger and fuller objective.

ACKNOWLEDGMENTS.—Much of the material herein presented has been gathered in connection with official studies of animal life conducted by the author under instructions from the

chiefs of the U. S. Biological Survey, C. Hart Merriam, H. W. Henshaw, E. W. Nelson, and Paul G. Redington, and in cordial coöperation with the officials of the National Park Service under the late Stephen T. Mather and Horace M. Albright. To the late Colonel (later General) L. M. Brett, while acting superintendent of the park, and his able assistant and successor, Chester A. Lindsley, as well as to many of the park rangers and naturalists, I am indebted for every possible assistance and much valuable information.

Permission to publish in book form the material thus in part gathered in connection with official duties is granted by the present chief of the Biological Survey, Paul G. Redington, and the director of the National Park Service, Horace M. Albright.



LIFE ZONES OF YELLOWSTONE PARK REGION

White above pink—Arctic Alpine Zone

Pink—Hudsonian Zone

Green—Canadian Zone

Blue—Transition Zone

CHAPTER II

LIFE ZONES OF YELLOW- STONE PARK

IN THE STUDY of distribution of animal and plant life we find certain species and groups of species limited to restricted areas, and when the causes for these limitations are sought the areas are generally found to depend on climatic conditions, such as approximately equal temperature, degree of humidity, type of air currents, and various local factors that modify the weather. The life of the tropics is very different from that of the arctic region but between the two extremes we divide the country into several other broad belts, or zones, into which a large part of the plant and animal life naturally falls in accordance with well defined laws of temperature control.

The same change of temperature is generally observed in going from the foot to the top of a high mountain as in going on level ground from the same starting point to the arctic regions, increase of altitude corresponding to extent of latitude in its effect upon climate. Thus in a mountainous region sections of many of the life zones of the continent may be found close together, lying vertically, one above another, instead of one north or south of another as in the low country. A thousand feet of altitude in the mountains may have the same effect upon the climate as half a thousand miles of latitude in the low country.

It is necessary to know some of the principles of life zone distribution in order to understand the presence of certain trees and plants and animals at certain levels and their absence from others that may seem equally attractive. This knowledge also makes possible more intelligent control of the animal life, just as a knowledge of the crops best adapted to the life zone in

which he is working enables the farmer to get the best results from his labor.

The greater part of Yellowstone Park is a high plateau lying approximately eight thousand feet above sea level. From this plateau many rugged peaks and ridges rise to an altitude of ten thousand to eleven thousand feet, while the larger valleys drop down to a level of five thousand three hundred on the north and six thousand three hundred on the south. The altitudinal variation within the park, while not great, is sufficient to give a range of climate including four of the transcontinental life zones, as shown on the accompanying map. These, beginning with the uppermost, are the *Arctic-Alpine Zone*, lying entirely above timberline on the peaks and ridges; the *Hudsonian Zone*, including the narrow belt of scrubby timber just below timberline; the *Canadian Zone*, of dense spruce and lodgepole pine forest; and the *Transition Zone* in the low open valleys. There is a trace of the warmer *Upper Sonoran Zone* at Gardiner but not sufficient to be shown on the map.

These zones, marked by groups of plants and animals adapted to similar climatic conditions, are parts of the broad belts that extend across the continent, but here in the mountains of the park they show merely as spots or broad areas except where the Hudsonian Zone surrounds the higher peaks and ridges in narrow belts on steep slopes. While the different zones carry their own groups of mammals, birds, insects, mollusks, and other forms of animal life, each is generally most readily recognized by its trees, shrubs, and conspicuous types of plant life.

At Gardiner, there are many *Upper Sonoran Zone* plants and animals but not sufficient to dominate the area so that it can be mapped as a part of the zone, which becomes well marked lower down in the Yellowstone Valley in the vicinity of Billings. These traces of the zone are indicated by the presence of such plants as greasebrush, white sage, spiny shadscale, grayia, tetradymia, and golden sage; and of such animals and birds as the cottontail rabbit and the Say phoebe. The practical value of this trace

is shown, however, in the climate and especially in the open winters of the Gardiner Basin, which proves a harbor of refuge for large numbers of the game animals of the park during the cold storms, severe weather, and deep snows of the higher and more exposed country. The dominant species of the basin, however, belong to the Transition Zone of the more extensive valleys above.

TRANSITION ZONE, as shown in blue on the map (facing page 9), comes into the park in limited areas in the lowest valleys. The largest and most important of these areas lies in the Gardiner, Yellowstone, and Lamar River valleys up to approximately seven thousand five hundred feet on southwest slopes and to six thousand five hundred feet on northeast slopes. At about the same levels smaller areas come into the Gallatin, Madison, and Falls River valleys on the west and into the Snake River valley on the south. A trace of the zone is seen in many species of plants on warm slopes at the north end of Yellowstone Lake and in Pelican Creek valley, but it is only a trace and not sufficiently strong to dominate the area.

The Transition Zone areas in Yellowstone Park are mainly treeless, except for narrow borders along the streams and on some steep rough slopes, where a few scrubby trees are found. For some unknown reason the yellow pine, which occupies the zone throughout most of the Rocky Mountain region, does not occur in the park, although its associate species are abundant. The valleys are largely open sagebrush or grassland with a great variety of shrubs and low vegetation. Some of the characteristic plants along the streams are narrow-leaved cottonwood, diamond willows, western birch, and alders; on steep banks, red cedar and limber pine; in thickets, chokecherry, serviceberry, gooseberry, wild currant, and wild rose; in the open, sagebrush, balsam root, wyethia, pink thistle, hawkweed, goldenrod, lupine, loco, larkspur, pentstemon, wild flax, geranium, Indian paint brush, bitterroot, cinquefoil, and wind flower.

Some of the characteristic Transition Zone mammals are the antelope, plains white-tailed deer, little sagebrush chipmunk, Uinta ground squirrel, bushy-tailed wood rat, white-tailed jack rabbit, Wyoming bobcat, northern skunk, and Yellowstone bat.

Some of the characteristic birds are the sage grouse, Columbian sharp-tailed grouse, Lewis's woodpecker, kingbird, western crow, Brewer's blackbird, western chipping sparrow, western vesper sparrow, western tanager, western warbling vireo, western yellow-throat, sage thrasher, and catbird.

The great value of this zone to the park lies in its relatively mild climate and light snow fall. In normal winters, elk, deer, buffaloes, and mountain sheep winter in comfort and safety in this zone within the limits of the park boundaries. Only in unusually severe winters are the elk driven below the northern line of the park. Along the western edge the usually somewhat deeper snows more often force them farther down the valleys.

CANADIAN ZONE, shown in green on the map, covers the greater part of the park over the middle elevations from about six thousand five hundred to eight thousand feet on northeast slopes and from seven thousand five hundred to nine thousand feet on southwest slopes. The general plateau level of the park falls entirely within this zone, which includes the main forest areas, some high open valleys, all the large lakes, as well as the three great geyser basins, the Yellowstone Canyon, and most of the scenic features of the park, which with their many charms and interests attract great numbers of summer visitors.

The zone is strongly characterized by its dense forests of lodgepole pine, Engelmann spruce, alpine fir, and aspen. Blue and Douglas spruce occupy the lower edge of the zone irregularly, white spruce grows in swamps, and the balsam poplar grows along some of the streams. The shrubby vegetation consists of willows along streams and marshes, shrubby juniper, dwarf birch, alder, rabbit berry (*Lepargyrea canadensis*), black currant, blue currant, red currant, red blueberry, dwarf blueberry,

fly honeysuckle, red-berried honeysuckle, red elderberry, thimbleberry, and mountain ash.

Some of the characteristic mammals of the Canadian Zone are Shiras's moose, elk, mule deer, pine squirrel, yellow-bellied chipmunk, mantled ground squirrel, golden woodchuck, mountain lemming mouse, Rocky Mountain meadow mouse, red-backed mouse, jumping mouse, yellow-haired porcupine, snowshoe rabbit, marten, wolverine, grizzly bear, water shrew, dusky shrew, and cinereous shrew.

Among the characteristic birds are Franklin's grouse, Richardson's grouse, arctic three-toed woodpecker, alpine three-toed woodpecker, red-naped sapsucker, olive-sided flycatcher, black-headed jay, Rocky Mountain jay, Clark's nutcracker, Rocky Mountain pine grosbeak, Bendire's crossbill, pine siskin, white-crowned sparrow, pink-sided junco, Lincoln's sparrow, Audubon's warbler, pileolated warbler, Rocky Mountain creeper, red-breasted nuthatch, mountain chickadee, ashy ruby-crowned kinglet, western golden-crowned kinglet, Townsend's solitaire, Audubon's hermit thrush, and olive-backed thrush.

HUDSONIAN ZONE, shown in pink on the map, is a relatively narrow belt of scrubby tree growth lying just below timberline around the higher peaks or ridges or capping some of the peaks that do not reach above timberline. It is rarely more than one thousand feet in vertical width but varies much with steepness and exposure of slopes, generally lying from about eight thousand to nine thousand feet on cold northeast exposures and from nine thousand to ten thousand on those of the warmer southwest. It consists largely of steep, rocky slopes, often more or less bare and open or covered by great snowbanks that lie late in summer, but also includes broad flower-covered areas, where the elk and the bighorn find ideal summer pasture.

The zone is characterized by scattered strips and patches of dwarf or scrubby timber of a few hardy types. Its most characteristic tree is the white-barked pine (*Pinus albicaulis*), with

which are often found dwarf alpine firs and Engelmann spruce straggling up from the Canadian Zone below. Its shrubs are a little bristly red currant, dwarf willows, mountain heather, and mountain laurel. Its flowering plants include, among many others, mountain cowslip, globe flower, subalpine larkspur, small-flowered lupine, dwarf clover, small-flowered shooting star, Venus looking glass, little bitterroot, mountain sorrel, dwarf phlox, Jacobs-ladder, and low forget-me-not.

The mammals of Hudsonian Zone are mainly such as extend up into it from the more sheltered Canadian Zone below, few if any, being restricted to its narrow limits. The great elk herds find in it their favorite summer resort, where above the troublesome insect pests of lower levels they revel in its cool air, frosty nights, and the luxuriant carpet of short rich grasses, clovers, and choice forage plants.

Most of the birds of the zone are merely summer visitors from the zone below; the alpine three-toed woodpeckers and Rocky Mountain pine grosbeaks nest mainly within the zone, and some of the white-crowned sparrows, juncos, warblers, and kinglets from below also breed and sing in this zone during the short bright summer, while the Clark's nutcrackers bring their broods of hungry young to feed on the nutlike seeds of the white-barked pine, and the Rocky Mountain jays occasionally come there.

ARCTIC-ALPINE ZONE, the uncolored area within the pink on the map, lies entirely above extreme timberline on the higher peaks and ridges, generally above ten thousand feet on warm sunny exposures and above nine thousand feet on cold shaded exposures. It varies considerably, however, with steepness of slope and form of topography, in cold much shaded northeastern gulches running lower and on warmer gentler slopes not so low. It is conspicuous from its extensive snowbanks and ice beds that remain on the peaks and lofty crests of ridges throughout the warmest parts of summer and until the peaks are again buried by new-fallen snows in the early autumn. Some of the

permanent snow fields are so deep and hard as to verge into glacial formation, and the water poured down all summer from these melting masses keeps the streams and lakes well filled.

The zone is devoid of timber or any upright shrubby vegetation, but patches of dwarf willows carpet moist spots, and many low plants cling to the earth and send up bright flowers during the short summer period when the snow leaves the exposed slopes. Among these are bright beds of pink catchfly, dainty blue mats of forget-me-nots, dwarf blue lungwort, little Jacobs-ladder, yellow sibbaldia, buttercup, cinquefoil, white alpine yarrow, alpine knot-weed, and many others of rare beauty and fragrance.

No mammal is characteristic of this zone, although some of the mice, shrews, and chipmunks probably stray into it from below, as they do in other parts of the Absaroka Range.

The black rosy finch undoubtedly breeds in the rocky slopes of some of the high peaks in the park as it does in the Absaroka Range just east of the park line, and a few other birds may be found breeding within the zone.

CHAPTER III

MAMMALS OF YELLOWSTONE PARK

HOOFED ANIMALS

AMERICAN BUFFALO; BISON

Bison bison bison (Linnaeus)

THESE LARGEST and once most important of our North American big game animals are so well known as to need no description. A comparatively few years ago the curly buffalo overcoats and warm winter robes were comforts to many of us, and now for a good picture of a buffalo we need go no further than the face of a current five-cent piece.

Not many years ago their numbers were so reduced that the species was seriously threatened with extinction but now, through their protection in Yellowstone Park and in other public and private refuges, all danger of extinction is passed and their numbers are steadily increasing. There are now over a thousand in Yellowstone Park in two herds, commonly known as the Lamar River herd, which in 1927 numbered nine hundred and thirty-six animals, and the mountain herd, which numbered at the same time about one hundred and twenty-five animals. These two herds have separate ranges, the mountain, or wild, herd being native to the mountains and the Lamar River herd having increased from animals introduced from the outside plains country.

The history of the wild herd is of special interest. In the early seventies buffaloes were recorded in what is now Yellowstone Park by the first exploring expeditions to enter it, but apparently they were much less numerous than in the lower valley country round about. In 1880 the report of the first superinten-

dent of the park gave an estimate of six hundred buffaloes distributed in three herds, about two hundred animals along the northern edge of the park, one hundred northwest of Yellowstone Lake, and three hundred on Madison Plateau in the western part of the park. In 1891, 1892, and 1893 the total number was estimated at four hundred, but in 1894 it was reduced to two hundred. During the mild winter of 1895 the buffaloes scattered out and did not come down to their regular wintering grounds, and only about thirty were seen in Hayden Valley, where they had usually wintered. Apparently many had left the park that winter, never to return, as not more than fifty were reported up to 1900, when twenty-nine were actually counted and a possible ten more were allowed for the entire park. In 1901 the wild herd of native buffaloes reached its lowest number, only twenty-five being reported, but since then it has shown a steady although very slow increase. In both summer and winter it has clung to its present range on the high plateau between the Upper Lamar River and Yellowstone Lake, mainly in the valley or along the sources of Pelican Creek from eight thousand to eight thousand five hundred feet altitude. Here in the summer of 1912, D. C. Nowlin counted thirty-seven buffaloes on Clover and Timothy creeks, and on April 12, 1914, M. P. Skinner reported thirty-eight on Pelican Creek. During July of 1915 I found their tracks common over the high country north of Mist Creek and along Raven and Willow creeks, but the flies were then so troublesome in the open that they had gone into the timber where they were not easily found. One moderately fresh track of an old bull was found on the trail along Mist Creek about half-way from where it joins Lamar River up to its source.

On this same trip I found big wolves common, feeding their young on elk, and probably also on buffaloes, as they were right in the midst of the buffalo range. This probably accounted for the slow rate of increase of the herd, for after the wolves were trapped out of this section the following winter by Donald Stevenson the herd began to make more rapid increase.

On December 4, 1915, Donald Stevenson counted thirty-one on their wintering ground along Pelican creek. In May, 1917, the park scouts counted sixty-seven animals in this herd and their numbers steadily increased until ten years later, in 1927, they numbered one hundred and twenty-five animals. This is a slow rate of increase for buffaloes, but in this high country they are living under extreme conditions of rigorous climate, short summers, and long cold winters with deep snow. Animals that have to paw through four feet of snow to get the dry grass beneath during seven months of the year, and for most of that time endure extremely low temperatures, are not likely to breed at as early an age or as regularly as they would under more favorable conditions. It would be strange if some of the calves did not perish during exceptionally deep snow and cold weather. Indeed, the endurance of these animals must arouse the wonder of all.

Whether these high mountain buffaloes are the same as those from the low hot plains of Texas and Mexico, where the species was first described and later, in 1758, named *Bos bison* by Linnaeus, or whether they belong to the usually unrecognized form from the high mountains of Colorado, will never be positively known until specimens of this wild mountain herd are preserved and studied in comparison with existing specimens in the larger museums from all parts of their original range. The whole group is sadly in need of revision, but for the present we can best follow Brewer and Allen in calling this merely the mountain bison. How or to what extent it differs from the plains bison of the south and east and from the woods bison of the Athabaska region in the far north is not well known.

Brewer in 1871 reported the "mountain buffalo" at eleven thousand feet in the mountains of Colorado as smaller, longer-haired, shaggier, and blacker than the plains animals.¹ Doctor Allen in 1874 found so many conflicting reports as to their characters that he gave little credence to a recognizable moun-

¹ Brewer, Thomas M. *Amer. Nat.*, vol. 5, p. 221, 1871.



Photo by Jack Haynes

FIG. 2. Part of Lamar Valley herd of buffaloes. All are fat and in fine fur when rounded up in fall and brought back to the buffalo ranch.



Photo by M. P. Skinner

Fig. 8 Buffalo cows and calves in the Lunat River Valley. In the spring the shaggy winter coats become ragged and worn and are gradually replaced by the thin summer coats. May 30, 1916.

tain form, although he says "the skulls met with in South Park and the Valley of the South Platt above Fairplay, averaged larger, by actual measurements, than those of the plains, with stouter and considerably longer and more spreading horns."²

The Indians in northern New Mexico claim that a larger, darker buffalo formerly ranged to the north of them and say that they had a different name for it.

Recent studies by Fryxell³ have shown how extensively the buffalo occupied the higher ranges in Colorado and Wyoming, from ten thousand to twelve thousand feet, and there is no reason to doubt that their adaptation to a rigorous environment may have developed characters by which to distinguish them from those of the lower plains.

The Lamar River herd probably may be safely called *Bison bison bison* as the first animals were shipped into the park in 1902 from the low country, eighteen cows from the Allard herd in Flathead Valley of western Montana, and three bulls from the Goodnight herd in northern Texas. These may possibly have been a mixture of two races but that is of little consequence, as we have in the museums for study numerous specimens of buffalo from over the plains country.

In 1908 the Lamar herd had increased to seventy-four animals, in 1911 to one hundred and forty-seven animals, in 1928 to eight hundred and ninety-six, and in 1929 to one thousand and ninety-two.

For several years the nucleus of this herd was kept in a pasture near Mammoth Hot Springs but then was moved to a more extensive pasture, comprising about a section of well-fenced bottomland on Lamar River at the mouth of Rose Creek. Here they spend the winters and receive a generous allowance of well cured wild-grass hay in addition to what dry grass they can dig from under the snow. In spring they are turned out of the pasture and headed up Lamar Valley to spend the summer in the

² Allen, J. A. Bull. Essex Inst., vol. 6, p. 55, 1874.

³ Fryxell, Fritiof M. Journal of Mammalogy, vol. 7, no. 2, p. 102, 1926.



FIG. 4. The tame herd in its winter pasture. These are beautiful animals in their full, soft winter robes that seem impervious to any degree of cold.



FIG. 5. Old bulls are inclined to be morose and solitary. With their huge size and great strength they have nothing to fear and they show a dignity becoming the Lords of the Plains.

high open valleys of Cache, Calfee, and Miller creeks. They require little attention until the autumn snows begin, when they are rounded up and brought back to their pasture for the winter.

A small herd of old bulls is brought back each spring to the Mammoth Hot Springs pasture and kept there during the tourist season so that visitors can feast their eyes on these original lords of the plains.

A trip to the buffalo ranch on Lamar River in early spring or late fall is well worth while, for the herd of about one thousand animals in their big pasture might well duplicate a scene on the Montana plains in the early days of the pioneers.

Snow and cold have little terror for these heavily clothed animals if a food supply is available. At feeding time the buffaloes gather about the pasture gates, and when the big loads of hay come in follow to eat the hay pitched off both sides of the road. When the snow is deep and all are hungry, there is much pushing and crowding and many fights among the young bulls and occasionally between the old herd-masters. Some of these fights are savage and malicious, but usually they are quickly over and the vanquished one makes a wild rush to escape his opponent, which attempts to catch him broadside as he turns. Occasionally one is cornered and killed, but for such clumsy appearing animals they are extremely agile.

It is dangerous to be on the ground among them, but on a hay wagon or on horseback one is comparatively safe. One needs to have a quick horse, however, and be a good rider to be absolutely safe, as some old cow or surly bull may make a sudden charge at close quarters from which only the experienced can escape. Do not "fool with" a buffalo nor a grizzly bear but especially not with a buffalo. Some have been misled by the name "tame herd," formerly applied to these animals, for while not afraid of man they are usually not over friendly.

Now that the problem of saving the buffalo from extinction has been solved and there are some eighteen thousand of them in North America, the immediate problem is what to do with

the surplus. The Yellowstone Park authorities have decided to limit the Lamar herd to approximately a thousand animals and in some way to dispose of the surplus. In 1926, when about two hundred Sierra Club members visited Yellowstone Park, Superintendent Albright, in his welcoming address at the first campfire, offered to give each a buffalo bull to take home. The records, however, do not show any sudden decrease in the herd that year!

MOUNTAIN SHEEP; ROCKY MOUNTAIN BIGHORN

Ovis canadensis canadensis Shaw

Mountain sheep occupy most of the higher mountain ranges in the park during summer and in winter many of them come down into the canyons and on steep lower slopes, where they find food and less snow than at higher levels. In 1907, the annual report of the superintendent gave an estimate of two hundred for the park. In 1909, about seventy were fed hay along the road from Gardiner to Mammoth Hot Springs. During the winter of 1910, about sixty were counted along this part of the road and one hundred and fifty were reported on Mount Everts and the Buffalo Plateau near Tower Falls. In 1911, D. C. Nowlin gave a total estimate of two hundred and fifty, based on numbers reported to him by the park scouts. The winters of 1913 and 1914 were mild and not so many sheep were seen, but they seemed to be holding their own, although two were found dead of scabies and there was considerable fear that the disease might spread and carry off large numbers, as it had in the mountains to the north.

In the summer of 1915 there were said to be a considerable number of mountain sheep in the Gallatin Range, west of Gardiner and Mammoth Hot Springs, and these were supposed to contribute in part to the numbers appearing in winter along Gardiner River Canyon below Mammoth. There were also some sheep on Mount Everts, Bunsen Peak, Garnet Hill, and the steep slopes north of Yellowstone River and Slough Creek; also

a considerable number on the Absaroka Range along the entire eastern side of the park and on the Trident Plateau. Others were reported on Two Ocean Plateau and Big Game Ridge. In 1926, the Sierra Club party found them on Trident Plateau, and on Mount Washburn, north of the canyon. They were also reported on Sheridan Peak in the Red Mountains west of Heart Lake.

In 1898, Seton published notes from Captain G. S. Anderson and Lieutenant Lindsley on the distribution of mountain sheep in the park at that time. Captain Anderson reported them as plentiful near the west line of the park and in the mountains east of Yellowstone Lake. The previous year he had seen a band of twelve on Amethyst Mountain and others were reported on Mount Everts and along Gardiner River Canyon and near Soda Butte. Lieutenant Lindsley reported them in the northeastern corner of the park and along the range between Swan Lake Flat and Madison Basin, and estimated that there were then about two hundred in the park. In 1912, Seton reported a dozen ewes with their lambs on Mount Washburn.

In May, 1916, Skinner counted thirty sheep along the slopes of Mount Everts and reported forty-six counted there in January. In March of that year I counted forty-four on or near Specimen Ridge and seventeen on Mount Norris, south of Soda Butte Creek. The total number in the park at that time was estimated at about two hundred, which was probably much too low as it did not take into consideration some of the more distant ranges where they are known to occur.

In 1924 the number was estimated by the Yellowstone Park rangers at six hundred and in 1926 the same estimate was given, based on an actual count of two hundred and seventeen individuals (Nature Notes, vol. 1, no. 8, p. 6, and vol. 3, no. 12, p. 6.).

In 1928, the official report gave five hundred as the total estimate for the park.

During the summer the sheep occupy mainly Hudsonian and Arctic-Alpine zones, near or above timberline on mountain peaks



Photo by M. P. Skinner

FIG. 6. A bunch of bighorn rams on Junction Butte, in Yellowstone Park, May 17, 1916.

and ranges, where they find abundance of choice food and a safe retreat from predatory animals as well as pestering flies. In winter they come down to the tops of wind-swept ridges, where snow never accumulates to any great depth and some feed is always available, or else they withdraw to the more comfortable canyon walls or sheltered slopes of the lower country, where deep snows do not last long but slide, blow, or melt off, leaving much exposed vegetation that has not been reached by other grazing or browsing animals.

At present the mountain sheep range in Yellowstone Park is lightly stocked and would carry several times as many animals without drawing on the food supply of other ruminants. It would seem that two thousand sheep for the park ranges would be none too many as a permanent breeding stock, but this number can be determined only by a careful study of their food and the carrying capacity of both winter and summer ranges. Any overstocking of the range may result in permanent injury and greatly reduced carrying power. Eventually there should be a regular surplus of all game animals to be disposed of in whatever manner may seem most desirable, preferably for stocking other parks or depleted ranges outside. A closer study of habits and methods of capturing, handling, and shipping such animals could well be made before the immediate necessity of disposing of them arises.

In food habits mountain sheep are generally considered grazing animals but they also do much browsing and grubbing, at least a part of the year, in winter eating the tips, buds, and branches of shrubs, pawing and digging out the basal leaves and roots of many plants, and eating some dried and well cured grasses and native plants from the cliffs and crevices of rocks, where other animals do not go. At times their stomach contents show much underground vegetation, fleshy roots that are evidently dug or pulled out of the ground. In summer they eat a little green grass but far more of the green and succulent plants such as wild clovers and other legumes, numerous flowering

plants, and the buds, flowers, seeds, and leaves of both herbaceous and shrubby vegetation. Those that come down in winter along the road between Gardiner and Mammoth are always eager for the alfalfa hay scattered for them and the deer. When fed in winter they soon become tame and could be domesticated to any degree desired and, if properly handled without being alarmed, could be captured and shipped or kept in inclosure for study or future disposal. Intelligent management of game animals is, in the near future, going to require a much fuller knowledge of habits and dispositions, and necessitate more ready means of keeping and shipping them from place to place.

Little has been recorded of the breeding habits of these mountain sheep, but one or two lambs, born sometime in May or June, seems to be the rule. Occasionally twins are seen with the mother ewe. During most of the year the ewes and lambs and young bucks range together, but the old rams generally keep by themselves in small bands. Seton (*Lives of Game Animals*, vol. 3, p. 553) gives the period of gestation as probably about one hundred and fifty days, as in the common sheep, but this would throw the mating season back only to January, which seems too late in winter. Donald Stevenson, in the Wind River Mountains, reports the mating season in November, when one old ram is found with each band of ewes and the other rams are scattered out, trying to force their way into the bunches but kept out by the champions until these are vanquished in fair fight by stronger rivals. This would indicate a seven months' gestation period, which seems more probable with these large animals, not closely related to our woolly domestic varieties of sheep.

The natural enemies of mountain sheep are many and to a great extent determine the character of country to which they are locally restricted. Wolves, coyotes, mountain lions, Canada lynxes, bobcats, bears, and eagles may be counted their principal enemies next to man and disease—mainly sheep scab, brought in by herds of domestic sheep. Only by keeping on almost inaccessible cliffs and peaks can they escape the ravages of wolves and

coyotes, but even here they are not safe from the big cats or the lambs from eagles. Indeed their lives are one long struggle for escape from enemies or in defense of the young.

Naturally quiet and gentle animals, they are exceedingly timid and their defense against numerous enemies lies mainly in their power of rapid flight over slopes so steep and rough that few can overtake them. To see a band of heavy-horned old rams bound from shelf to shelf up a cliff that from below looks perpendicular, or at full speed throw themselves over the edge of a precipice that from above seems to lead to bottomless depths, is no less awe-inspiring when one painfully risks the well-worn trails, niches, shelves, and footholds along the rough walls that they follow.

Their greatest enemy, man, is at last becoming their protector by controlling the abundance of predatory animals and by rigorously stamping out scabies from the herds of domestic sheep that often in the past have come in contact with their range. The scab apparently kills scattered bands or individuals and without a source of re-infection, dies out or fails to reach other herds, so becoming ever less of a menace to the species. With still more foresight man could greatly increase the number of these interesting and valuable game animals and insure the perpetuation of the species as well as restore them to many parts of their original range now devoid of large mammals.

Few of our large game animals have a greater lure to the sportsman in search of adventure and worthy trophies, and most of those familiar with our native game will agree that none yields a more delicious food than the mountain sheep. Their greatest value, however, lies in the fact that thousands of visitors to the park may here see them on their native range.

PRONGHORN; PRONG-HORNED ANTELOPE; AMERICAN ANTELOPE
Antilocapra americana americana (Ord)

Antelopes are still common in the northern part of Yellowstone Park in the low, open valleys of the Yellowstone, Gardi-

ner, and Lamar rivers and over some of the open ridges leading back to higher country. They are regularly migratory in habits, spending the summers mainly in the valleys of Lamar and Yellowstone rivers and along Slough Creek; in autumn drifting down through the Yellowstone Valley to the warm valleys below Gardiner, where they spend the winter; in spring drifting back along the same route to their summer range. A few usually remain in the vicinity of Gardiner during summer, where they may be seen by passing tourists, but during July and August they are found mainly along the Lamar River valley up as far as Soda Butte Creek and over the open slopes of Specimen Ridge, scattered in bunches of three or four to six or eight.

In 1908 about two thousand were estimated in the park but during the following winter all but twenty-five escaped through the park fence below Gardiner and went down to the lower valleys, where at that time they were unprotected, and many never returned. In 1911 only four hundred and fifty were counted in the park. In 1914 six hundred were estimated in the park herd, and in 1916 five hundred. In the spring of 1917 most of these left the park and later, when driven back, only about two hundred were accounted for. On March 23, 1925, park naturalist Sawyer and chief ranger Woodring (Yellowstone Nature Notes) counted four hundred and seventeen antelope as they were moving back to their summer range, and in March, 1927, six hundred and forty-one were counted. These figures indicate a very gratifying increase in the park herd caused, undoubtedly, by their recently protected wintering grounds below the park, and to the active control of wolves and coyotes on their summer range. With still more vigorous control of their enemies, the perpetuation of this herd, and of the species that recently seemed doomed to extinction, is practically assured. Many other herds over the country are also increasing and, with fuller knowledge and awakened interest, we no longer face the disgrace of having another of our native species exterminated from the face of the earth.



Photo by Albert Schleichien

FIG. 7. Antelope in spring in Yellowstone Park.

Few animals are more fleet or wary than the pronghorn, but some peculiarities render them an easy prey to enemies and especially to hunters. Their curiosity in regard to any object that they do not recognize or understand, such as a hand or hat or handkerchief waved above the sagebrush, often leads them to approach, and many have thus been shot at close range. Also their gregarious habits, especially on migratory journeys, have exposed them to destruction by hunters and other enemies. Moreover, in spite of great speed and keen senses, they are often at a sad disadvantage with their natural enemies, the wolves and coyotes. When caught in deep snow, or snow with a crust that will not quite hold them, they are entirely at the mercy of these enemies and many are thus destroyed. Their greatest danger, however, is through loss of the young by prowling coyotes before they are old enough to run with the mother and receive her protection, or to escape by their own swiftness.

The summer range of the antelope in the park was the favorite range of coyotes until they were systematically killed off, and it has long been evident that these animals were the chief cause of the scarcity of young so often noticeable in the park herd. Every spring shows a few antelopes killed and partly eaten by coyotes during the winter, and in summer many young are known to be killed though these are usually eaten bones and all, or carried away to coyote dens.

Chief ranger Woodring, in *Nature Notes* for December, 1928, gives an interesting account of two coyotes catching, killing, and eating a full-grown antelope on the Buffalo Ranch in October. Taking advantage of a plowed field, they ran the animal over soft ground until it was tired out, cutting across its circles, and finally pulling it down and feasting on it, just over the ridge from the man plowing in the field and watching the chase. No matter how thoroughly the coyotes are eliminated from this valley in winter, others come in every summer, and the supply will never be exhausted. Eternal vigilance will always be the price of saving this herd of antelopes.

Young antelopes are born usually late in May or early in June, after the herds have reached the summer range, and the number seems to be more often two than one. At birth they are remarkably slender, delicate creatures, beautifully marked with white and brown on buffy coats, though less strikingly colored than the adults. The white markings are at first obscured by buffy-tipped long hairs and the general colors blend into the dry grass and gray sagebrush so perfectly that when crouched flat upon the ground they are as invisible as nighthawks, and seem



FIG. 8. Antelope in the alfalfa field at Gardiner, September 22, 1915.

to sense the value of lying tight. When almost stepped on they bound away with surprising speed, even when but a few days old, and while still small begin to run with the mother and to keep up with her in a hard race. By midsummer the young are running with the small bunches, which gather for the fall migration in September and October.

The mating season begins late in September while the does are in small groups of three to five, and each old buck, with much strident grunting, is almost constantly on the run, excitedly herding his little harem, chasing away the younger bucks, and rounding up and bringing back any member of his own bunch of does

that tries to stray away. At times he becomes almost frantic in his efforts to keep his bunch together and fierce fights take place between rival leaders. The younger bucks hang around the outside of the circle and meekly run as fast and as far as they are chased, but no farther, and then usually work back toward the does. Before the end of October the excitement is over, the spirit of rivalry has ceased, and all mingle freely in the larger bands of the fall migration.



Photo by M. P. Skinner

FIG. 9. Young antelope hiding in the short grass of the open valley, June 4, 1916.

In Yellowstone Park, Skinner says, the horns of the bucks are all shed during November and early December, the new ones already growing. In fact, new horn growth begins before the deciduous sheath is lost and really pushes it off from the long bony core. At first the new horn material is merely a soft black skin, but it soon develops a dense covering of long fine hairs and a hard horny tip, which gradually extends downward toward the base of the horn until the whole sheath is hard and firm and the basal hairs are partly absorbed into the horny matrix, or are worn off from the surface. Apparently the horns are not wholly matured until late in the spring or early in the summer. One taken from a recently killed buck on March 9 was hard for only

a few inches down below the tip and was still covered with soft skin and hair well beyond the budding prong.

The horns of the bucks are useful mainly as weapons of supremacy and are out of commission for about half of the year, when the greatest danger from enemies would be expected; but the effective weapons of both males and females are the hard and pointed hoofs of the front feet, which can be used with deadly effect.

The pronghorns are apparently, to some extent, grazing animals but our knowledge of their actual food habits is disgracefully meager. While nibbling at the ground they may be eating the low rich grasses or may be selecting more succulent legumes and flowering plants. They are fond of alfalfa and spend days in the big field at Gardiner feasting on the young or full-grown crop, daintily picking the leaves and blossoms and then lying down to chew their cuds in the alfalfa or at the edge of the field. They also nip the heads from growing grain and in winter eat the tips, buds, and leaves of sagebrush, rabbitbrush, and many of the dry plants. In places they have been accused of eating the ripening grains in fields of wheat and oats. In early April near Gardiner I have found the stomachs of several killed by coyotes well filled with both green and dry grass, but in March in the Green River valley they were eating the tops of sagebrush, rabbitbrush, snakebrush (*Gutierrezia*), and white sage (*Eurotia*), where the tips reached above the shallow snow on the ridges.

At times antelope meat has a strong flavor of sagebrush (*Artemisia*), but this does not necessarily mean that this exceedingly bitter wormwood forms any great part of their food. Generally they are free from any strong flavor and when in prime condition in the fall the meat is deliciously sweet and tender. It lacks some of the distinctive flavor and character of venison or elk meat but has sufficient merit of its own to rank high as wild game. If through wanton destruction of these beautiful animals a few generations are denied the enjoyment of a real delicacy there is still hope that future generations may have the satis-

faction of a limited supply from carefully protected or semi-domesticated herds. Why should we ignorantly limit our fare to a few domestic meats, derived by our ancient ancestors from animals of other countries, when far more delicious viands among our native animals are ignored and wasted?

YELLOWSTONE MOOSE; SHIRAS'S MOOSE

Alces americanus shirasi Nelson.

This Rocky Mountain form of the moose is distinguished from the eastern animal by a wash of rusty brown over the neck and back, and by grayer ears and smaller feet and antlers, differences not noticeable in the field but conspicuous when specimens are compared. Little was known of the local habits or habitat of these moose until a careful study of them was made in 1908 and 1910 by Honorable George Shiras, 3rd, and the results published in *Forest and Stream*, and the *National Geographic Magazine*.⁴ The estimate of one thousand five hundred moose in the valley of the Upper Yellowstone River, as made by Shiras, was a great surprise to both naturalists and park authorities, but the fact that during a few weeks' stay in the valley he counted some three hundred moose and saw as many as twenty-one at one time, would seem to substantiate his estimate. M. P. Skinner also reported them abundant along the Upper Yellowstone in 1913. While engaged in a study of the elk problem in and around Yellowstone Park in 1915, I covered a large part of the moose country and the number of animals seen and their tracks and signs fully satisfied me as to the abundance of the moose at that time. To actually count all of the scattered forest animals, even of the size of a moose, is impossible. A considerable area of the Yellowstone Valley, containing much of the best moose country, lies south of the park line and repeated open seasons on moose in Wyoming have considerably reduced their numbers. The number of moose actually living within the bounds of Yellowstone Park is probably much less than in 1910. In 1926 the

⁴ National Geog. Mag., vol. 24, no. 7, p. 833, July, 1913.

park rangers counted one hundred and three and estimated five hundred and seventy-five. The official estimate for 1929 was six hundred and seventy-five.

DISTRIBUTION.—While their greatest abundance is in favorite valleys such as the Upper Yellowstone and the Falls River Basin, moose are found scattered practically all over the timbered area of the park in Canadian Zone. They are entirely absent from the higher and more open elevations and mountain ranges, and scarce in the low, open Transition Zone valleys. Along the West Gallatin River, forest rangers and guides report a few seen every year. Axel Johnson, forest guard on Cinamon Creek, saw two on the headwaters of Sage Creek in the spring of 1915 and he told me that during the previous fall two were shot and left lying in the woods in Gallatin Valley just below the corner of the park. Probably these were shot for elk by mistake, and then left because the hunters were afraid to claim them. The previous year a cow and a calf moose were seen following the road along the river below the corner of the park. On the banks of Slough Creek, where it enters the northeastern corner of the park, a moose was seen on August 3, near Silver-tip Lodge, by Mrs. Robert C. Morris; and Mr. Ames of Silver-tip Lodge said that during the previous year he had seen several moose along that part of Slough Creek. Dr. Albright reported two moose seen on Slough Creek in October, 1927, and fourteen in 1928.

In following up the valley of Lamar River, I first struck moose tracks in the timbered bottoms above Miller Creek and found signs fairly common on Mist Creek and along the east side of Raven Creek. Again unmistakable moose sign was seen in several places in the dense timber along the east side of Yellowstone Lake, but the first animals seen were near where Beaverdam Creek comes into the southeast arm of Yellowstone Lake. Thence up the Yellowstone Valley to Bridgers Lake, during the latter half of July, moose were seen every day in small numbers through the timber and along the trails.

While I did not see more than five moose in a day, their tracks and signs were so abundant as to indicate a large number of the animals throughout this valley and the side valleys of Trapper and Mountain creeks. A few moose and numerous signs were seen along the southern line of the park from Bridgers Lake west to Snake River and southward to Jackson Lake; and on the return trip tracks were seen in the snow crossing the wagon road back and forth south of Lewis Lake. In the southwestern cor-



Photo by Honorable George Shrus, 3d

FIG. 10. Bull and cow moose in Upper Yellowstone Valley.

ner of the park the animals are said to be common throughout the Falls River basin country, and they are frequently killed along the Idaho line in that vicinity. The great Pitchstone and Madison plateaus, with their densely timbered flats and gentle slopes, are all ideal country for moose that, judged by their tracks seen south and west of Yellowstone Lake, are distributed more or less commonly throughout this region.

Doctor Albright says: "A cow moose and twin calves stopped the car carrying Secretary Hubert Work, Director Mather and

myself six miles south of Mammoth on the road to Norris on June 30, 1926, by calmly walking across the road in front of the car." "In 1921," he says, "twenty-seven moose were counted between the Southeast Arm and Mountain Creek in Upper Yellowstone in a two hours' ride along the trail."

Evidently the moose have been increasing during the years of protection afforded them in the park and adjoining states, as the early reports made little mention of them. A skull of a cow moose brought back from the Teton Mountains in 1872 by C. Hart Merriam, naturalist of the Hayden Survey, was probably the first record for that region and for the species, but Doctor Merriam tells me that very few moose were seen in the park on that trip. In fact, the increase seems to have been very rapid during recent years.

GENERAL HABITS.—Unlike many of the large game animals, moose seem to have only very local migratory instinct, preferring their home ground so long as they are undisturbed and food is abundant. Snow of a moderate depth is of little inconvenience to their long legs, and even where it is very deep their habit of yarding and keeping a small area well trampled enables them to endure the severest winters.

Apparently the snow is not usually deep enough to force them to yard in the Upper Yellowstone Valley, for along the main valley and the valleys of side streams, I watched carefully for evidence of yards without finding a trace of them, old or recent. The willows were browsed and in places, especially along Mountain Creek, often cut down to mere stumps, but not in a manner to indicate a long pasturage in one locality. Winter sign of moose is often seen in the timber among second growth and in places of abundant brush, also in the open flats where extensive willow thickets cover much of the valley. Thirty or forty square miles of dense willow thickets interspersed with open meadows along the Upper Yellowstone Valley furnish abundant food of the choicest kind for winter moose pasture, while an equal area in Falls River basin and extensive willow

thickets along Snake River and its branches, as well as many other sections throughout the park, afford an unlimited supply of winter food. The rich grasses and meadow plants, besides a great variety of forest shrubs, afford so much food throughout the year that the range would not be overstocked if there were five thousand instead of five hundred in the park. Their food plants and the character of summer and winter range required by them do not conflict with those of elk or other game animals,



Photo by honorable George Shiras, 3d

FIG. 11. Bull moose in willows of Upper Yellowstone Valley.

and there seems no reason why their increase should not be encouraged for many years to come.

Along the roads moose are rarely seen, but on the trails the passing tourist may note their huge forms as with swinging stride they glide through the woods, over the softest marshes, or plunge unhalting through rivers and lakes; or he may watch them feeding half-submerged along the lake shores. Of the actual everyday habits of the moose in summer and winter, comparatively little is known. To the naturalist with time and patience and a

love of the woods, a rare opportunity to study them is afforded in the park.

FOOD HABITS.—The plants eaten by the moose are not easily determined, except for the willows, which along the Yellowstone show heavy browsing, evidently attributable almost entirely to moose. In one case I was able to watch a pair of moose calves nibbling the leaves and twigs from wild honeysuckle bushes (*Lonicera conjugialis*), but in most cases it was impossible to tell what species of plants they were feeding upon. The grass showed no indication of being grazed and very little could be learned of the summer food plants, but the summer sign was easily distinguished from that of either elk or cattle by its large element of coarse woody fiber. The winter sign is mainly woody fiber, consisting of sawdust pellets an inch and a half long and a half inch in diameter, regularly molded and rounded at the ends and so firmly packed as to keep their form and character throughout the summer, even where lying on damp ground and subjected to numerous heavy rains. In fact, the winter moose sign is a larger and coarser edition of the sawdust pellets of the porcupine, which also lives on bark and wood.

BREEDING HABITS.—The mating season begins late. Shiras saw no indications of it up to the last of September and heard only a few bulls calling. I have no records of the time the calves are born, but there is a record of two embryos about the size of chipmunks, taken from a cow killed on December 11. By the middle of July we found calves running with their mothers, although at that time many cows were seen alone. Calves seen on September 14 were large and especially tall, but still kept close to their mothers and seemed very dependent upon her care and protection. Two calves are so often seen with a cow that twins seem the rule rather than the exception.

ANTLERS.—A few old shed antlers were found along the trails, but nothing to add interest to the valuable collection previously brought out by Mr. Shiras, and fully described and illustrated

in *Forest and Stream*.⁵ Up to the first of September the antlers of all the bulls were in the velvet, and those of several killed by hunters in early September in the region south of the park were still in this condition. Shiras says of those in the park: ". . . as late as October 1 not half the bull moose had their antlers free of velvet." Skinner reported a pine tree freshly rubbed on October 6 by moose antlers. Apparently the moose are about a month later than the elk in shedding the velvet, and the mating season seems to be at least a month later than with the elk.

AMERICAN ELK; WAPITI

Cervus canadensis canadensis (Erxleben)

The number of elk inhabiting Yellowstone Park varies greatly with the season and also at the same season one year with another. The migratory habits of the animals carry them from the high mountain ranges in midsummer to the low valleys in winter, and considerable time is occupied in this wandering back and forth. A severe winter of deep snow may bring many thousands into a restricted valley, while a mild winter of light snow may leave them scattered throughout many higher valleys in the mountains and bring none into the lower refuge. Their numbers on the summer range are also irregular and far more difficult to determine than on the winter range, as they are then scattered over a great extent of rough mountain country, the herds are constantly moving, and if frightened on one mountain the animals may cross a valley and climb another, passing in or out of the park, as the case may be.

Of the several great herds, it is impossible to tell how many occupy the park during the summer and how many the equally attractive ranges of the national forests around its borders. A general increase in their numbers in the park has been assumed, but the early records are indefinite and at present the elk are probably decreasing. In 1891 the superintendent of the park in his annual report gave an estimate of twenty-five thousand

⁵ Vol. 75, no. 5, p. 171, July 30, 1910.

elk, with the statement that their numbers had increased enormously. In 1899 his report gave thirty-five thousand as a minimum estimate for the park. In 1907, twenty-five thousand was given as a minimum estimate and forty thousand as a maximum, and in 1909 and 1910, thirty thousand to forty thousand were estimated. In 1912 a winter count of the numbers in the northern herd was made by park authorities and forest rangers, and thirty thousand, one hundred and one were given in the superintendent's report for that year, while a total number of fifty thousand was estimated for the region in and around the park. A general census, taken April 11 to May 2, 1914, of the northern herd occupying the Yellowstone, Lamar, and West Gallatin valleys gave the number as thirty-five thousand two hundred and eight. In May and June of 1917 a very thorough count and careful estimate of elk in the northern herd gave approximately twenty thousand animals. In 1925, seventeen thousand two hundred and forty-two were estimated; in 1927, seventeen thousand three hundred and forty-seven; in 1928, fourteen thousand one hundred and fifty, and in 1929, thirteen thousand three hundred and nine, in the northern herd, including the Gallatin herd.

Of the southern herd, which winters in Jackson Hole, the great valley south of the park, only a few scattered bulls remain in the park during the winter, but in summer a large number from this herd occupy the mountain ranges south of Yellowstone Lake. In March, 1916, twenty-four thousand eight hundred and ninety were counted and estimated in the southern herd. Several small herds wintering in the valleys along the western side of the Big-horn Basin undoubtedly draw part of their numbers from the elk of Yellowstone Park, but not enough to affect noticeably the present estimates of either herd. In the spring of 1926 the Jackson Hole herd was counted and estimated at nineteen thousand four hundred and forty-three. The carrying capacity limit of this winter range has been provisionally established as twenty thousand animals. For both the southern and northern herds there is ample summer range of the choicest kind, but the num-



Photo by Atwood

FIG. 12. Elk feeding on hay provided for them in winter.

bers of elk must be limited to actual carrying capacity of available winter range. At present both herds seem well adapted to their food supply, in normal seasons, but under unfavorable conditions of drouth in summer or heavy snows in winter they will need extra feed and careful attention.

In the early days of the west the elk moved down to the Green River and Snake River valleys to the south and far along the Yellowstone Valley in Montana to the north of the park, where sheltering timber and dense willow thickets of the river bottoms afforded choice winter feed and comfortable cover for vast numbers. But these valleys have long been valuable ranch and stock lands from which the elk have been excluded, being forced to take up higher winter grounds.

WINTER RANGE: With the first snows, usually in September, the elk leave the high mountain peaks and ridges and start on their migration to winter quarters. Not until the heavy storms force them out of the mountains, however, do they come to their real winter range. The northern herd drifts down into the Lamar, Yellowstone, Gardiner, and Gallatin River valleys and on the bare slopes and crests of the adjoining ridges, where they feed until the snow begins to recede in the spring. Usually the snowfall is not very heavy in these semi-arid basins and the elk are able to paw down to the grass and ground vegetation without much trouble. On many steep slopes and ridges the snow blows off and leaves the well-cured grass exposed, and even when the snow becomes too deep to be pawed away, the willow bottoms and aspen groves furnish a supply of food that is always available.

In case of very deep snow, hunger compels the animals to make a start for lower country, and the trails that the leaders break are followed by the younger and weaker animals until an area with available food is found—in severe winters, mainly down the Yellowstone River valley north of the park. During normal winters the snowfall on the main elk winter range in the park is light, being rarely more than eighteen inches in the Soda



Photo by Nelson E. Hall

FIG. 13. Elk feeding on alfalfa hay near Gardiner.

Butte, Slough Creek, Lamar, Yellowstone, and Gardiner valleys. The elk usually winter comfortably with very little loss or suffering. A few of the old animals and a few weak calves do not survive the winter, and formerly the wolves laid a heavy tribute on the herds in certain sections.

Examination of elk bones found on the winter range generally indicates very old animals with teeth worn to the base and often many of the molars missing, showing that the animals have actually died of old age; or else they are the bones of calves with weak teeth which, during hard winters, suffer severely and often die in considerable numbers because they can not paw through the deep snows for food, or reach the higher browse that the adults are able to obtain. The relatively small number of bones of animals in the prime of life are usually not more than could be attributed to the ravages of predatory animals and those seriously wounded during the open season outside the park. As the bones remain on the ground for at least four or five years they serve as a good index to winter conditions for several years back. In 1915 traces of old bones from the hard winter of 1910-1911 were found in sheltered places, where the elk had gathered to die in pitiful groups; but from that time up to the spring of 1917, the winter loss had been very light. The heavy snow and late, cold spring of 1917 resulted in an unusually heavy loss on the winter ranges, both north and south of the park, but the mortality among the elk was less than that among range cattle.

At Gardiner a few elk are usually fed with the antelope, deer, and mountain sheep on hay cut and stacked up or shipped in for that purpose, but usually there is little demand for artificial feeding in this region.

Many of the old bull elk do not come down with the main herds to their winter range, but remain in higher valleys throughout the mountains, where they are able to get through the deep snow and cold winter and come out in good condition in spring. A few such usually winter in the southeastern corner of the park

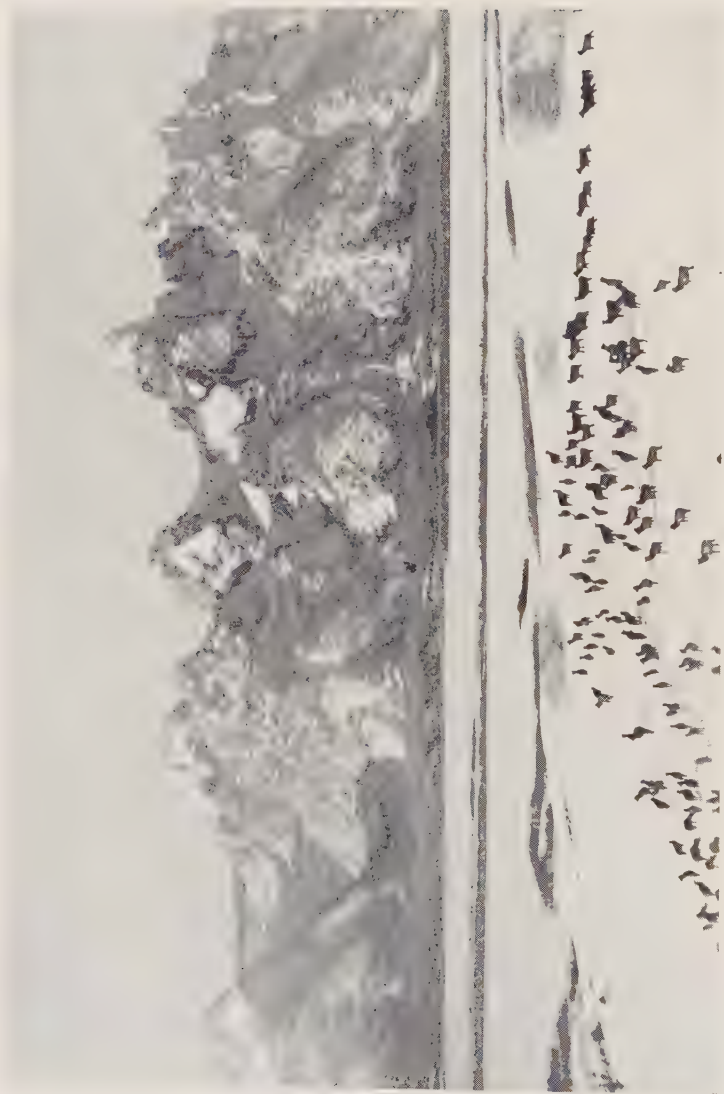


Photo by S. N. Leek

FIG. 14. Elk on their winter range in Jackson Hole, a great open valley sheltered on the west by Teton Mountains and Grand Teton Peak.

near Bridgers Lake on the headwaters of Snake River and in similar valleys throughout the mountains. Occasionally the bones of an old bull are found well up in the mountains, but almost invariably with worn-out teeth, showing that the normal limit of life had been reached.

With the southern herd conditions are very different. Not all of these elk summer in the park but many do and others



FIG. 15. Typical elk winter range on wind swept summit of Specimen Ridge, March 9, 1916.

summer in ranges to the south and southeast of the borders, all in high country where the ample summer feed is deeply buried under early snows and practically all of the elk are forced to lower levels. Most of these animals move down along regular trails into the great valley known as Jackson Valley, or the lower part of it known as Jackson Hole, and even farther into Hoback Valley and the Canyon of Snake River. A few may cross over into Upper Green River valley and mix with those from the Wind River Mountains, but the greater Jackson Valley carries most of the elk from the southern slopes of the park region.

Jackson Valley, lying entirely above six thousand five hundred feet altitude, has a Transition Zone climate, bordering close onto the Canadian, and is unsuited for agriculture, except grazing, and is not really good grazing land because of the long cold winters during which stock must be fed. It offers much excellent summer range, however, and has long been used for



FIG. 16. Elk trailing through deep snow in spring, in Gardiner River Valley, March 13, 1916.

ranch purposes and is generally occupied by ranches located on the best of the open valley bottoms. In recent years "dude ranches" have grown up in parts of the valley, and have somewhat increased the population so that, more and more, the desirable winter feed grounds for elk have been occupied. Only by the establishment of elk refuges where summer feed could be protected for the winter supply has it been possible to maintain the present number (approaching twenty thousand animals) in this southern herd, and there is still need for a greater area to insure a food supply and to cut down the necessity of feeding hay during a part of each winter.



Photo by M. P. Skinner

FIG. 17. Elk calf about two days old, near Garnet Hill, May 19, 1916.



Photo by M. P. Skinner

FIG. 18. Elf calf about two days old, near Garnet Hill, May 19, 1916 This photograph and the one in Figure 17 are untouched and the spotting shows in actual comparison with the spotted high-lights on surrounding vegetation.

The present studies of elk habits, migrations, food, and diseases, being carried on by the Biological Survey, the National Park Service, U. S. Forest Service, and state game departments should soon enable us to handle the rather complex elk problems with far greater efficiency than in past years.

As the snow recedes before the warm days of spring, the elk leave their well grazed winter grounds for the open slopes, where green grass first starts, and gradually work back over the higher and ungrazed slopes. Lines of old and well worn trails show their regular routes of migration back to their summer grounds, but it is a long and slow journey of several months, while they graze on the fresh grass and new twigs along the way and the cows wait for their calves to grow strong enough to follow them, before they reach their midsummer pastures.

On July 20, 1915, while camped at eight thousand five hundred feet altitude near the head of Fawn Creek in the Gallatin Range in the northwestern part of the park, with a field glass I could make out elk herds on the high ridges south, west, and north of camp. By climbing cautiously, so as not to disturb the elk, up to ten thousand feet on Quadrant Mountain south of camp, I was soon in the midst of one of their choice summer ranges. Small herds and scattered individuals were seen over the big open slopes above timberline; bunches of old bulls with full-grown velvety antlers were lying on top of the ridges, where the wind was strongest and insects least troublesome; calves and yearlings played over great snow banks on the cold slopes; and cows were peacefully lying down in meadows of rich short grass and clover. Little streams and pools of ice-cold water were everywhere abundant and the elk were a picture of contentment and satisfaction in this their ideal summer home.

After about an hour a large grizzly bear that had been digging mice on a neighboring slope was seen walking across toward the elk, and as he came in view their heads went up and the herds near me gathered into one dense mass of about five hundred, old and young, when the bear walked past close in front of them

and on over the ridge, scarcely turning his head to notice them. The herd was a beautiful sight, twenty-five or thirty old bulls with sets of large antlers towering above numerous small ones while the front ranks were mainly filled with anxious cows ready to give battle for the protection of their young. When the bear had disappeared the herds quietly dispersed to their grazing and seemed very little concerned.

While watching this band of elk I also swept my field glass over the ridges to the north and west, where numerous other herds were seen feeding in similar situations above timberline. In one herd I counted eighty-six, in others, seventy, thirty-four, thirty-four, nineteen, and twelve, but this was a small fraction of the numbers on invisible slopes of the amphitheater. In the valley of Fawn Creek numerous well worn trails crossed back and forth from one ridge to the other, but none of the animals was seen in the valley or below the ragged edge of timberline at about nine thousand feet. On the west slope of the range, however, a few individuals were seen down in the midst of the timber zone, where they were evidently attracted by salt licks, or springs of brackish water.

During the month of August scattered herds were found over Mirror Plateau from Amethyst Mountain to Mist Creek and in the ranges east of Lamar River and farther south along the high crests of the Absaroka Range to the extreme southeastern corner of the park. On the headwaters of Raven and Pelican creeks, August 10, bunches of three or four to seventy-five were found in almost every little park and meadow over the plateau, which lies close to nine thousand feet altitude. At this season they were greatly tormented by flies, and while lying in the meadow grass or in the shade of scrubby spruces their heads were often swaying and their ears flapping in vain efforts to get rid of their tormentors. Mirror Plateau is a favorite summer range of the elk, but the ridges are not high enough to afford perfect protection from insect pests during the hot days of August. In some cases the elk go into dense timber to escape from

the flies, but where possible they climb to wind-swept ridges above timberline.

On the big ridges south of Mist Creek bands of elk could be seen with a field glass about Pyramid, Cathedral, and Chittenden peaks, and along the east side of Yellowstone Lake well worn trails led down from the ridges farther east, traveled by elk going to visit the various salt licks or to escape from disturbing conditions on one ridge by crossing over to another. Even the steep sides of the Trident Mountains showed well used elk trails, but I did not get to the top of this great plateau so admirably adapted to summer elk range. On the eighteenth and nineteenth of August elk herds were numerous over the tops of Two Ocean Plateau and Big Game Ridge, mainly near or above timberline, while many trails led across to adjoining ridges. Later, about the middle of September, numerous elk trails were seen in the snow leading down from Red Mountain and Flat Mountain south of the lake, indicating that these form also an important part of the summer range of the southern herd. The great Pitchstone and Madison plateaus in the western part of the park and the lower country west of Yellowstone Lake are at present little used as summer range, partly because they are not high enough, and partly because the great herds of elk that originally wintered in the valleys west of the park have been killed. While many elk drift through this region on the migrations, few remain for summer or winter range.

At the present time, within the boundaries of the park, the midsummer range of the elk is very largely restricted to the Hudsonian, or Timberline Zone, while the winter range is practically coincident with the Transition Zone area of the lowest valleys. The spring and fall migrations, which occupy nearly half the year, carry them back and forth through the great timbered Canadian Zone area, all of which contribute to their food supply.

FOOD HABITS.—In summer the food of the elk consists of grasses and a great variety of herbaceous plants, but also includes

some leaves, buds, and twigs of shrubs. The best summer pastures are on the high mountain slopes, where a dense carpet of low, rich grasses, including a little mountain timothy, are mingled with several species of dwarfed clovers and a great variety of flowering plants. The wide choice of food in these high mountain meadows is so great that the largest herds of elk make little impression upon it, but the actual species of plants eaten, or those preferred, are not easily determined.



FIG. 19. Willows browsed by elk in winter near the Tower Falls Ranger Station, March 10, 1916.

Grasses and sedges apparently form a large part of the food at times but numerous other plants are grazed and some small shrubs and woody plants show where the tops have been eaten, even in summer. The mountain maple seems to be a favorite browse and is eagerly eaten wherever found.

In winter in the valleys the food of the elk changes to dry grasses, numerous flowering plants, and a great variety of shrubs, browse, and even bark. Willows of many species are an abundant source of food supply along the streams and meadows. They are often trimmed to mere stumps during the winter and in

some places they are actually killed out by close browsing. Apparently all species of willows are eaten without much discrimination. Other shrubs that are extensively browsed are the mountain maple, serviceberry, wild rose, snowberry, fly honeysuckle, young aspen, and cottonwood. Some sagebrush, rabbitbrush, *Grayia*, *Atriplex*, and white sage are eaten, and in places the twigs and small branches of the spruce, fir, and lodgepole pine are trimmed as high as the elk can reach during times of deep snow. This is a hard-times food, however, and often marks the location where elk have died in considerable numbers during the winter. In times of deep or crusted snow the intensely bitter bark of the aspen tree is eaten, but this too is a food of the last resort. In places whole groves have been killed by being stripped of the bark. Few young aspens are allowed to mature on the elk range.

Skinner (*Journal of Mammalogy*, vol. 9, no. 4, November, 1928), lists among the summer food of elk, grasses, wild strawberry, balsam root, geranium, potentilla, thistles, clover, lungwort, wild carrot, eriogonum, lupine, asters, dogtooth lily, wild sunflowers, paint brush, cow parsnip; and the winter food, October to March, as stems, leaves, and seeds of wild sunflower, lupine, larkspur, cow parsnip, low huckleberry, mushrooms, grasses, rudbeckia, aspen, bearberry, thistles, shrubby cinquefoil, wild rose, gooseberry, currant, fireweed, sedges, willows, asters, wild rye grass, aspen (bark), cottonwood, rabbitbrush, sagebrush, western birch, red cedar, Douglas spruce, limber pine, and other conifers. While this shows the wide range of plants used as food, a more detailed study of these plants and their food values is important.

Elk show great fondness for salt and in summer travel long distances to reach certain springs, which are generally alkaline though only slightly impregnated with saline matter. Many of these so-called "salt licks" are most uninviting mudholes, but the elk lick and nibble the incrustations from the surface of the mud and often wear deep holes into the banks in their

eagerness for the mineral matter. They also gnaw the prongs from many of the antlers shed by the bulls in early spring and sometimes chew up prongs and most of the beam of some of the smaller antlers, evidently in quest of salt or mineral matter. This habit seems to be very general among elk, not only in zoölogical parks, but on their native range, a large proportion of the antlers found lying on the ground having been more or less gnawed during spring and summer.



FIG. 20. Willows in summer, showing effect of winter browsing by elk, near Yanceys, July 15, 1915.

BREEDING HABITS.—The cows normally give birth to but one calf, which is usually born late in May or early in June, during the spring migration and at a time when fresh grass is starting and food is abundant. When the calves are a few weeks old they begin to follow their mothers and soon join the herds that gather on the summer range. Late in the summer, after losing their spots, they are seen with the herds and their shrill whistling, accompanied by the harsh barking notes of the cows, can be heard when danger is feared. During the early part of

the open hunting season, which generally begins September 1, in areas adjacent to the park many of the cows are still nursing their young, and even by the first of October not all of the calves are weaned. The rut begins in September and lasts well into or through October, and the period of gestation is approximately eight and one-half months.

ANTLERS.—At first it seems quite incomprehensible that the enormous antlers of a bull elk should be shed and renewed each year, and the wonder increases as one rides in July over the



FIG. 21. Fence of shed elk horns around the old Yancey stage station, July, 1915.

undisturbed range where hundreds of antlers have dropped along the trails and finally comes to the old bulls already supplied with new full-grown antlers covered with beautiful soft brown velvet. On July 20 a large number of old bulls on Quadrant Mountain showed full-sized antlers, but the young bulls and "spikes" or yearling bulls, were still with short, club-shaped and usually about half-grown sets. On August 19, on Big Game Ridge in the southern part of the park, a few of the largest bulls showed antlers with white points, where the velvet had fallen away or had been rubbed off against the trees. On the same date a few freshly rubbed trees were seen, the first of

the season, from which the bark had been rubbed and the fresh pitch was starting to flow. By the first of September the antlers of the old bulls are usually fully peeled, well rubbed, and polished, and the more vigorous bulls are beginning to bugle forth their fighting challenge. The antlers are worn through the winter, but in March and April the old ones drop off and are left scattered over the mountain slopes. Soon the new antlers begin to grow from the old stumps, and in about five months they are full-grown, hardened, peeled, polished, and ready for the fighting season.

MOLT.—The thin, brown summer coats of the elk, according to Skinner, are acquired during the latter part of May and the early part of June. The paler, more buffy winter coats are put on in September and grow paler by fading through the winter until their well bleached and ragged remnants are again discarded in May. There is not, however, the striking color change seen in the winter and summer coats of deer. The young are reddish brown, coarsely spotted with white, but the spotting seems to be lost rather early in summer.

ENEMIES OF THE ELK.—In the past the great enemies of the elk herds have been wolves and coyotes, the big wolves in winter pulling them down on their feeding grounds and chasing them from place to place, the coyotes in summer following the herds and killing as many calves as can be surprised away from their mothers. Both of these enemies are now almost under control.

Mountain lions once laid heavy tribute on the elk of the Yellowstone country but are no longer a serious menace. Lynxes, bobcats, and bears may get a few calves or sick or crippled adults, but were never a great factor in reducing the herds.

Disease and starvation have been important elements in the destruction of the elk but both are being brought under control with more thorough study and more careful management of the winter herds, and before long we can undoubtedly eliminate or greatly reduce these sources of loss.

Hunting in past years, including poaching, tooth hunting, and taking advantage of early storms that drive down great numbers of elk into hunting areas during the open season, have caused some of the most serious losses and threatened the destruction of the species. A vivid picture of the butchery methods of unsportsmanlike meat-hunting given by Skinner (*Journal of Mammalogy*, November, 1928), will arouse the ire of any true sportsman, though it is mild in comparison with some of the earlier methods used around the borders of the park. Skinner speaks from first-hand knowledge but many of the old timers can tell of even worse slaughter. To remedy such conditions we first must know and understand them.

ROCKY MOUNTAIN MULE DEER

Odocoileus hemionus macrotis (Say)

This mule deer, the largest and finest of our common deer, with forked antlers, huge ears, and little stumpy black-tipped tail, inhabits practically the whole Rocky Mountain region of the United States but is becoming scarce over much of its original range. In the rough mountain areas and especially in the Yellowstone Park region it is holding its own better than elsewhere and in places is still fairly common.

In summer mule deer are generally distributed over practically all of Yellowstone Park, but, like other animals, they have their favorite areas or types of country and they are to some extent migratory in habits. At this season a few are seen around Mammoth Hot Springs and in the low country along the northern part of the park, others well up in the mountains, in dense forests, open beaver meadows, and in creek valleys. At any season their tracks prove the best index to their numbers. Great numbers of tracks were found on fresh snow in September along the western border of Yellowstone Lake and along the road from the canyon of the Yellowstone to Norris Geyser Basin. Tracks were abundant also through the dense forest along Lewis River and in many places between Lewis Lake and The Thumb.

In this central part of the park the deer evidently do not so often stray over the line and come in contact with hunters. It is probable also that they seek the protection of the extensive windfalls that have followed forest fires, where the great numbers of prostrate logs afford them protection from such enemies as wolves, coyotes, and mountain lions. At any rate, the tracks were invariably most abundant there. Tracks were often seen in the half-open country near timberline, but apparently, unlike the elk, the deer are not often driven above timberline to escape the flies. In winter there is a slight movement to the lower valleys, but it is less marked and regular than the migrations of the elk. It is especially noticeable at Gardiner and Mammoth Hot Springs, where for many years in winter the deer have been in the habit of coming for hay provided for them and other game animals. The number gathering here in winter is generally considered the best index to the abundance of deer in the park, but it varies greatly with the severity of the season.

According to the annual reports of the superintendent of the park, in the winter of 1904, one hundred and twenty mule deer were counted in one day at Mammoth Hot Springs. In 1907 the estimate of the scouts was one thousand for the park. In 1908, three hundred or four hundred were fed alfalfa in the vicinity of the Mammoth Hot Springs, and in 1909 the number was given as five hundred. In 1910 about eight hundred were fed hay about Gardiner and Mammoth Hot Springs. In 1911 the reports gave one thousand mule deer counted in that vicinity, but this was a hard winter, and some died. In 1912 only four hundred were counted, but this was an open winter and the deer did not come down in their usual numbers and it is probable also that the loss of the previous winter had to some extent diminished their numbers. During mild winters fewer deer came down to be fed but in the coldest winters there are few losses. Even in the severe cold of the spring of 1917 there seemed to be no great loss of deer. Judging from the available records and from my own observations, during the summer of

1915, the spring of 1916 and fall of 1917, I estimated that there were at least two thousand mule deer within the limits of the park, while outside of its boundaries they were extremely scarce. In 1924 the park rangers estimated one thousand eight hundred, and in 1926, one thousand eight hundred and fifty in the park (Nature Notes). In 1928 the official estimate was two thousand.



Photo by Jack Haynes

FIG. 22. Mule deer in winter at Fort Yellowstone.

During July and August the deer were in the thin summer "red coat" of bright yellowish brown. Skinner reported the first red coat as seen on June 17. The hair at this time is so thin and short that in many places the dark skin shows through, especially on the great, almost naked ears. The meager little tail is slender and mainly white with a black tip. The fawns are much the color of their parents with rows of white spots over the sides and back. Red-coated deer were seen up to the middle of August, and one old doe, on August 19, was beginning to show patches of gray through the red coat and seemed to be

about half-way through the fall molt. On September 12 an old doe and her fawn at Mammoth Hot Springs were about half in the gray winter coat, while two bucks with them were in the full gray coats with the velvet hanging in strings from their antlers. On September 14 an old doe near The Thumb was in the full prime of fresh winter pelage in its darkest form. The dark, smoky gray coat, black breast and face markings, and rich buff rump patch of the fresh fall coat blended so perfectly with the shadows of the woods by the roadside that my photograph at one hundred feet proved worthless. During the winter the colors fade until the spring pelage is a clear light gray and the light rump patch and base of the tail are pure white. The colors are palest and most faded just before the spring molt, which occurs in May.

ANTLERS.—The mule deer shed their antlers during the latter part of winter, but at no fixed date. The time varies from January to March, depending in part on the condition of the deer and the nature of the season. On March 2, 1916, the old bucks had all shed but none of the young bucks had, while on March 12 very few antlers could be seen on any of the deer. In April, with the opening of spring and the appearance of fresh grass, new antlers start from the old bases and grow rapidly. By July 20 the light brown, velvet-covered antlers are almost full-grown, and early in September the velvet has usually peeled and the antlers are hard, well rubbed, and polished. A few shed antlers of the mule deer are found over the mountain slopes and in the valleys and are always recognizable by the forked instead of single beam. Many of the antlers found lying on the ground are gnawed or partly eaten by rodents, but I have not seen any that showed evidence of being gnawed by the deer.

FOOD HABITS.—In summer the deer browse on a great variety of plants, selecting the leaves, buds, twigs, and often the flowers or seed capsules. In the forest back of Mammoth Hot Springs I watched two young bucks for some time as they were feeding

along the trail. They were so gentle that I could easily approach within ten feet as they nibbled the leaves and buds from the branches of the Canadian buffalo-berry (*Lepargyreus cana-*



FIG. 23. Mule deer buck reaching for a piece of apple in an open window at Mammoth Hot Springs.

densis). In the woods this seemed to be their favorite food, and in many places I noticed that the tips of this bush had been browsed. Skinner watched them eating the leaves and buds of

raspberry and rose bushes, and in yards the shrubbery has to be protected from them during winter. Out in the sagebrush they seem to find many plants that are acceptable, as they daintily pick and nibble from one and then another, but at no time, except in April, did I see them eat grass. Then it was just starting and they were frequently seen picking the green blades with evident relish. In winter they are eager for alfalfa hay and would doubtless accept even timothy or wild-grass hay under winter conditions. They feed from the loads of hay that are hauled out and scattered for the antelope, sheep, and deer, and at such times become very tame and pay little attention to men.

BREEDING HABITS.—The mating season in the park is in November and one, or more often two, and rarely three fawns are born in June.⁶ They are beautiful little spotted creatures that are kept hidden in secluded nooks until late in the summer, when the spots are lost and they are old enough to run with the mother. They are not so commonly seen as the young elk or antelope, but they have great need of cover, for their enemies are numerous. The coyotes, bobcats, and Canada lynxes undoubtedly get a certain proportion of them. One skull of a fawn that had been partly eaten by coyotes was found near Crescent Hill. But for these enemies the deer in the park would be much more numerous, as they are prolific breeders and should increase rapidly if even half the young were allowed to mature. Of course it is not desirable to destroy all of any species, but too many coyotes mean too few deer, elk, and antelopes.

WHITE-TAILED DEER

Odocoileus virginianus macrourus (Rafinesque)

The white-tailed deer, though much less common and less generally distributed than the mule deer, were still often seen in the park up to 1924, when eight were counted and forty estimated for the park (*Nature Notes*). Since that time they seem to

⁶ In 1916 Skinner reported the first fawn seen on June 25.

have entirely disappeared. They were mainly in the lower valleys but a few were found over the more open parts of the plateau. Their favorite haunts were willow and aspen thickets along streams or groves along the edges of open parks and meadows. During the summer of 1915 a few were seen around Mammoth Hot Springs, Yanceys, Tower Falls, and at the north-



Photo by Albert Schlechten

FIG. 24. White-tail and mule deer does in spring in the willow bottoms along Gardiner River. Note positions of long, metatarsal gland on hind leg of mule deer and small gland on left leg of white-tail.

ern end of Yellowstone Lake, and a few generally hung around the Soldier Station on Snake River at the southern entrance of the park. The annual report of the superintendent of the park for 1907 gives an estimate of one hundred white-tailed deer; in 1909, sixty were fed alfalfa in the vicinity of Mammoth Hot Springs and Gardiner; in 1910 and 1911, and in 1912, about one hundred were reported as coming to the feeding grounds for hay. During the hard winter of 1911, when some of the mule deer perished, there was said to be no loss of white-tails.

In habits white-tailed deer seem generally more shy and secretive than mule deer, but in the park they were just as tame and unsuspecting. On August 14, 1915, at the north end of the lake a fine old buck in light yellowish red summer coat and full-grown velvet-covered antlers stood at the edge of the woods while I rode up to a distance of a hundred feet to try to photograph him, and although he moved just enough to spoil each of the films, he was not alarmed and walked into the woods only when his curiosity was satisfied. During the summer of 1915 an old doe and two fawns were often seen near the Soldier Station at the south line of the park and were said to be comparatively tame. They had disappeared just before my arrival and there was some fear that their tameness had betrayed them to unscrupulous campers below the line. On September 18 two old does, each accompanied by a large fawn, were feeding on the lawn in front of the Mammoth Hot Springs Hotel. They were so gentle that tourists were photographing them at any distance they chose, and the children were feeding them bread from their hands. At this time one of the does was in the buffy gray winter coat and the other and the two large unspotted fawns were still in the yellow summer coats. The tourist season was then over and carpenters were busy nailing chicken wire around the small trees and shrubbery in the door yards and on the lawns at Mammoth Hot Springs and Fort Yellowstone to protect them from being browsed down by the deer during winter.

When the snow became deep the deer picked the buds and twigs from such bushes and low branches of trees as they could reach, and were particularly fond of rose haws and rose twigs. They browsed on the tips of willows and a great variety of shrubs as they wandered about in small bands in the thickets or over the hills and slopes. They begged for food about the doors of houses, eagerly devouring the parings of potatoes or apples that were thrown out, looking expectantly at passersby as if they hoped for some small contribution of food. They



Photo by Nelson E. Hall

FIG. 25. White-tail deer in early winter, near Gardiner, Montana.

ate hay from the wagons in company with the mule deer, antelope, and mountain sheep, and picked the scattered hay along the roadsides where it was thrown out for them. In their dense winter coats of light gray they always looked sleek and well fed, and not until warm weather appeared did they begin to show ragged and worn coats.

The antlers of the bucks were carried through most of the winter and usually, but not always, dropped in February. Skinner reported a buck that had shed one antler on January 29, but another seen on March 2 was still carrying a fair-sized set of antlers.

The beautifully spotted fawns were so well hidden in the thickets that they were rarely seen and at least a few escaped the prowling coyotes, lynxes and other big cats in summer. But on their return in fall many of the does were alone or with only one instead of the two fawns that should have accompanied them.

To a limited degree they were migratory in habits. Usually a part of those in the park drifted down the river valley in winter below the boundary where they had little protection and were an easy prey to pot hunters. A protected area below the park line could have saved them but this was not provided.

Over most of the western country it seems to be impossible to protect these deer and they have steadily melted away before the settlements until there seems no hope for their existence outside of such areas as the park. Now they are gone from this one spot, where they might have been protected. It should not be difficult to bring back a few from farther down the Yellowstone or Missouri valleys and restock the park with the same subspecies native to it. Possibly a few may wander back to their old ranges in the park. Certainly they should not be allowed to disappear from the one spot where they might be perpetuated.

GNAWING ANIMALS

BANGS' FLYING SQUIRREL

Glaucomys sabrinus bangsi (Rhoads)

These large buffy brown flying squirrels are fairly common throughout the forests surrounding Yellowstone Park and are often caught in traps set for martens, minks, and other forest fur bearers. Seton reported them as common,⁷ but Captain Anderson doubted the statement, as he had seen only two or three during a long residence in the park. As a matter of fact they are probably much more common than is supposed, being strictly nocturnal and very quiet and secretive in habits. Their beautiful rich brown fur is so soft and downy that their motions are as noiseless as those of the owl, and as they do not willingly come out of their nests during daylight, they may visit your camp every night without being seen or heard. As they usually live in the deepest woods, their presence is often overlooked. Apparently they are never numerous like the red squirrels and chipmunks, but generally they are widely distributed over the forest areas.

In *Nature Notes* for July, 1926, park naturalist Sawyer reports two flying squirrels taken from a hollow telephone pole in Elk Park, near Norris Basin, and kept for some time in captivity at park headquarters, where they afforded great interest to those who saw them.

Late one evening, in July, 1915, while camped on the West Gallatin River near the northwestern corner of the park, I saw a shadow pass over my campfire and heard a soft tap of little feet against the trunk of a neighboring spruce tree. A few blows of the axe on the trunk of the tree produced the expected results. From near the top a large flying squirrel sailed down on widespread membranes, curved out over the willow thicket across to the edge of the woods, then turned upward, and its feet patted against the bark of one of the forest trees, where it silently disappeared into the night.

⁷ Recreation, p. 365, May, 1898.

The homes of flying squirrels are by preference in the trunks of hollow trees, but in a purely coniferous forest, where hollow trees rarely occur, they undoubtedly adopt the expedient of building nests of soft material in the branches, somewhat after the fashion of the pine squirrel. In fact, some of the nests credited to pine squirrels are not improbably those of flying squirrels.

Of their nocturnal habits little is known, except that they visit camp grounds where grain and scraps of food are scattered, and are often caught in traps set in the woods for fur-bearing animals and baited with fresh meat, bird feathers, or rabbit fur. Apparently they are rather omnivorous in habits, as they readily accept rolled oats, grain, and nuts used as trap bait, or pieces of bread or biscuit found around camps. On rare occasions they get into some unoccupied cabin in the woods and help themselves to the food supplies or make nests out of parts of clothing intended for other purposes. The little mischief they do, however, is so rare that their interest and beauty far outweigh any slight annoyance they may occasion.

They make gentle and affectionate pets but are sleepy in the daytime and most active while we are asleep. Still they can be shown in nest boxes with glass and outer doors that may be opened for a peek at the occupants of the nest at any time.

WIND RIVER PINE SQUIRREL; RED SQUIRREL

Sciurus hudsonicus ventorum (Allen)

These little dark reddish-brown tree squirrels are the only representatives of the true squirrels in Yellowstone Park. They are abundant throughout the coniferous forest, completely filling the Canadian Zone area from its lower limits on the timbered slopes near Mammoth Hot Springs to the edge of Hudsonian Zone at about nine thousand feet on the higher ranges. They are seen along the roadsides and at nearly every camp in the woods and are one of the cheeriest and brightest of the smaller denizens of the forest. Their spirited *chr-r-r-r-r* often rings



FIG. 26. Pine squirrel feeding in Douglas spruce near Mammoth Hot Springs.

through the trees, especially at sunrise, and in autumn the thumping of their dropping cones can be heard far and near.

Over the ground and logs the squirrels scurry in their eagerness to provide a good winter store of food or to chase intruders away from their precious hoards. One does not have to go far from any of the camps to find a squirrel that, with a little patient coaxing, can be approached on friendly terms or that, if not too busy, will come down closely to examine and perhaps scold his visitor. In the groves back of Mammoth the squirrels have become so accustomed to harmless tourists and sightseers that they will sit unconcernedly on a log by the roadside or even in one side of the road while the people pass by. The absence of dogs, cats, and guns from the park has given all of the wild creatures a surprising confidence in man's good intentions and in none is this more noticeable than in the squirrels.

As they are active throughout the year it is necessary for them to build warm nests and store up ample food supplies. The coniferous timber affords few hollow trees and the squirrels are obliged to depend mainly on their own resources for dwellings. They build the large, bulky nests of bark, fibers, moss, grass, and leaves commonly seen in the branches of trees. Generally the nest is in the form of a ball, often a foot in diameter, compactly matted together, and securely anchored among the branches or close against the trunk of a tree. One or two doorways open into the sides or lower part, and soft warm nest material lines the inner cavity. The nests are always clean and dry inside, and for warmth and comfort compare well with any sleeping bag of man's invention. One nest, found on the ground, had evidently been thrown down from a tree by a bear or some other climbing animal of large size, and another was found carefully placed by the squirrel under a fallen tree top, where large branches protected it from intruders and where, when buried deeply under the snow, it would form a safe and comfortable winter retreat. Others were found under the dry

cone scales of deep refuse heaps close to extensive winter stores of seed-laden cones.

In winter the red squirrels' fur becomes exceedingly full and soft, covering even the greater part of the soles of the feet, and the animals are as active and comfortable as in summer, scampering over the crusted snow or burrowing through its mellow depths to the surface of the earth, where by means of snow tunnels they reach their cached food supplies. Deep snow has no terrors for them as they are able to keep open their tunnels below its surface and to reach their stores of food, even during the severest storms.



FIG. 27. Twenty bushels of cone scales under Engelmann spruce where pine squirrels feed in winter. Nest on branch near top of picture.

FOOD HABITS.—The greater part of their food throughout the year consists of seeds from cones of various evergreens. The seeds of the lodgepole pine furnish most of it, simply because this is the most abundant and widely distributed tree, but in the strip of woods back of Mammoth Hot Springs I once found in Sep-

tember a store where a squirrel had cached about two bushels of the long cones of the limber pine (*Pinus flexilis*) dropping them in and around an old log, tucking some down holes and half-burying others among old cone scales and pine needles. Up near timberline the cones of *Pinus albicaulis* supply a choice food for winter or summer. In other places cones of the Douglas spruce are buried singly or in bunches in little depressions in the ground or in holes the squirrels dig to receive them. The heaps of old cone scales from a last year's food

supply are often used as storehouses, but in many places the cones are simply piled against logs or in hollows without any attempt at cover or concealment.

To get the seed from the cones, the squirrels with their chisel-like teeth cut off the scales at the base, exposing under each scale one or two plump seeds with rich oily meats. These are eaten and the process goes on until a full meal is obtained from one or several of the cones. Often great heaps of ten to twenty



FIG. 28. Winter nest of pine squirrel on branch of lodgepole pine in Upper Geyser Basin, September 7, 1927.

bushels of cone scales accumulate under trees in which the squirrels habitually sit while feeding. The cone supply not only lasts through the winter but often through much of the following summer. In July the squirrels dig up old cones of the previous year and shell out and eat the seeds, but in August they cut fresh cones with plump, well filled seeds, although not until early September do they begin in earnest to store their winter supply.

During the summer, however, the squirrels find a great variety of fresh food, including the nutritious oily seeds of many plants

of the wild sunflower family and even seeds of grasses and many other small plants. They seem especially fond of the seeds of the compass plant (*Balsamorhiza sagittata*), and will run out into the open and gather the heads and bring them back to the logs or to their tree branches to be eaten at leisure. They are often seen carrying or eating small woods mushrooms



FIG. 29. Cones and seed of *Pinus albicaulis*. From the cone on the left the scales have been cut and seeds eaten by a pine squirrel; the one on the right has been chewed up and the seeds extracted and eaten by a grizzly bear. Near Upper Geyser Basin, September 5, 1917.

of different kinds and these are frequently found cached with their other winter supplies or tucked into crevices in the bark or branches of trees, where they can be easily reached.

Each squirrel guards his cache with great care, chasing other squirrels from the vicinity and if necessary furiously attacking any trespasser. The hoarders generally respect each others rights, however, and if one accidentally treads upon the ground of a neighbor and is caught in the act, he almost invariably acknowledges his fault by rapid flight.

The mating season for these squirrels is early spring and the young are born in May or June, but they do not appear out of the nests until well into July, when fully half-grown and well able to take care of themselves. There are usually four to six in a litter, very helpless at birth and slow in developing but well cared for in safe warm nests by the mother. In September the young are practically full-grown and are taking an active part in storing food, nest building, and winter preparations but they are still to some extent under their mother's supervision.

These squirrels are too small to be of much value as food and even in unprotected areas they are not usually considered legitimate game or of value for fur. Their value consists chiefly in the interest and brightness that they add to the somber forest, and fortunately they have no injurious habits to condemn them. Indeed their habit of storing cones has made them of great value, and since it has been discovered that the cones that they store always contain the best growing seeds, heavy tribute is often laid on their stores by seed gatherers; thus they aid indirectly in reforestation.

In times of scarcity of other winter food they sometimes cut the tips of branches of the lodgepole pine, eat the sweet bark of the twigs, and scatter the tips thickly over the surface of the snow. This bark-eating habit is rarely of importance, however, and is not sufficiently regular in any locality to affect the growth of the trees.

There is no danger of the red squirrels ever becoming too numerous for they have many hungry enemies such as hawks, owls, martens, and weasels. On the whole, our relations with these bright little foresters should be most cordial.

YELLOW-BELLIED CHIPMUNK

Eutamias amoenus luteiventris (Allen)

These bright, active little chipmunks with many-striped backs and yellow bellies are the most abundant and generally distributed of the several species inhabiting the park. Although scarce

or absent in the higher ranges, they are especially numerous in the lower levels throughout Transition and the edges of Canadian Zone. They are conspicuous along the roadsides, about old campsites, in the edges of forests, and over old windfalls, burns, and log jams. Few mammals are more numerous or more often seen in the park. They sit on the logs by the roadside and, as the noisy stages pass, dodge out of sight or scamper away. They are largely ground or log dwellers, occasionally climbing trees, but if alarmed more often running for a hole in the ground, a hollow log, or a brush heap.

Though quick and nervous they soon lose their fear if you approach them slowly, talking or whistling softly. If you have the time and patience to sit still a little while on their feeding grounds they will presently come near, gathering and eating the seeds of grasses and various plants within a few feet of you; but their nerves are always tense and a quick movement or sharp sound will send them scampering and chipping in great fright to the nearest cover. At abandoned camp sites, where grain and scraps of food have been scattered, they often gather in considerable numbers, and as the stages drive up sometimes a dozen or more may be seen fleeing for the bushes.

At times, if food is not well protected, they become troublesome about camps, getting into everything of an edible nature that is left open, cutting holes in grain sacks and helping themselves liberally, and often wasting much more than they take. A dozen chipmunks actively filling their cheek pouches with oats and scampering back and forth from their storehouses for new supplies will in the course of a day remove an extravagant quantity of grain. At some of the rangers' cabins around the park, tin-lined cupboards were built to protect the provisions from both chipmunks and mice, and the grain for the horses was safely stored in tight boxes or bins. The chipmunks were made to feel welcome to the crumbs and scraps of food that were thrown out, and repaid the confidence of their thoughtful

hosts by friendly visits to the porch and even to the kitchen and dining-room table.

At the ranger cabin on Slough Creek near the park line a family of chipmunks had made their home under the floor and were as tame as the horses that leaned over the fence to be fed and petted, or the juncos and chipping sparrows that picked up crumbs from the doorstep. It seems unfortunate that dogs and cats are so often preferred to chipmunks and the other timid wild creatures of the forest, but in the park the freedom from predatory cats and dogs has resulted in a remarkable friendliness in all the little diurnal animals. On the roads the chipmunks would hardly get out of the way of my horse, and many times I swayed him quickly to one side for fear he would step on one, though their lightninglike quickness is generally ample protection from such danger. They have many natural enemies, hawks, owls, weasels, martens, and foxes, to keep the necessary check on their increase, but as these are more common in unfrequented sections the chipmunks are safest and naturally most in evidence along the roadsides and in the vicinity of camps.

Their food consists mainly of seeds, grain, berries, a few insects, bread crumbs, scraps of meat, and other food from camps. In late summer and early autumn the wise little providers are very busy laying up supplies for the winter. Their cheek pouches are often distended with seeds and other provisions selected for the winter stores in the food chambers underground. Unlike the caches of the squirrels, their stores are placed in cavities close to their winter nests.

The chipmunks do not become fat in fall and probably do not strictly hibernate, although during the deep snows of winter they are missing and only re-appear with the first warm days of spring. During the winter they evidently feed to some extent upon the stores in their underground homes. If they pass into a state of actual lethargy at all it is probably not so long or complete as in species that do not store food but store up quan-

titles of fat inside their bodies to be drawn upon during the long winter sleep. From the first heavy snows of November to the warm days of March and April their tracks are not seen in the mountains, but just what they do or how they live during that interval remains to be determined.

LARGE-TAILED CHIPMUNK; UINTA CHIPMUNK

Eutamias umbrinus (Allen)

These large, white-bellied chipmunks, with broad black stripes on the back and conspicuously bushy tails, occur outside along the east, south, and west sides of the park, but so far as I know have been observed at only one locality within its boundaries. On September 21, 1915, two were seen on the rocks along the Cooke City road, between Undine Falls and Gardiner River. They were very tame and sat so close to the road that I could examine them at a distance of ten feet almost as carefully as though I had specimens in my hand, and their characters were unmistakable.

They were at the edge of the spruce and pine woods that cover the mountain side, although both were in the open, one on a large rock eating seeds from a spruce cone, the other on the stone wall eating wild currants; and both, when approached too closely, took refuge in the crevices among the rocks. Cone scales and bits of many plants from which they had been shell-ing the seeds were scattered over the rocks, and evidently these two, only a short distance apart, were storing their winter food supply, where it would be available when the deep snows should cover the mountain side. In habits they differ but little from the yellow-bellied chipmunks, but they have a more dignified manner and are less inclined to sudden panic, while their voice is clearer and more birdlike.

WASATCH CHIPMUNK

Eutamias minimus consobrinus (Allen)

Specimens of the little dark-colored, white-bellied chipmunks have been taken near the north end of Yellowstone Lake, and

near the eastern and southern boundaries in the park. Many were seen over Two Ocean Plateau, Big Game Ridge, along the Snake River, along the shores of Yellowstone Lake, and in the high open valleys of the park. They are much smaller than the yellow-bellied chipmunks but it is difficult to distinguish them except at close quarters, for the white belly is generally hidden as they scamper away from the sides of the trail. Apparently their range extends somewhat higher than that of the yellow-



Photo by E. R. Warren

FIG. 30. The little Wasatch chipmunk of the high plateau country.

bellied, and many were seen near timberline in the southern part of the park. They live more especially in the open country or in scattered timber or even among rocks and sagebrush.

In habits as well as appearance they differ but little from the yellow-bellied chipmunks, except as their environment affords different conditions of life and different species of food plants, but their voices are finer and more rapid than in those of the larger species. High up in the mountains they are buried in deep snow for five or six months, but in the valleys they are ac-

tive as long as warm weather lasts. On October 14, chipmunk tracks were common in the first fresh snow along Snake and Lewis rivers, and not until the snow becomes deep and the weather severe do they finally disappear for the winter.

LITTLE GRAY CHIPMUNK

Eutamias minimus clarus Bailey

Little gray chipmunks are common in Swan Lake Valley and about Mammoth Hot Springs in the open sagebrush areas. A specimen was collected in Swan Lake Valley and one in Snow Pass, and they were frequently seen along the roads and trails, running over the ground with slender tails held straight up, dodging among the sagebrushes, or scampering along logs or the bottom rails of old fences. They are among the smallest of all the chipmunks. In finely striped backs and clear gray sides they closely resemble the little sagebrush chipmunk (*Eutamias pictus*) from the Idaho plains. However, on careful comparison they prove to be merely a pale gray form of *minimus*, occupying the open valleys along the northern edge of its range.

They are sage plains animals, rarely entering even the edge of the timber, but inhabiting the sagebrush valleys, where they make their homes in burrows and run from one bush to another, climbing through the branches of the sagebrush in search of food, or sitting on the tops of the tallest bushes, uttering their weak little chipper as a call-note or note of warning to others of the family. The sagebrush affords as good protection to them as do the tall bushes and forest trees to many of the larger species. They scamper from one bush to another with such lightninglike speed that they are soon lost to view even if they do not take refuge in some of their numerous burrows under the bushes.

Their food consists of the seeds of sagebrush and a great variety of smaller plants, grasses, and little underground tubers and bulbs which they well know how to find. In the lower valleys they may be active throughout the winter, but they are

busy storers of food and the heavy storms and deep snows have no terrors for them, as they are able to remain comfortably housed below the surface as long as necessary.

GRAY-MANTLED GROUND SQUIRREL

Callospermophilus lateralis cinerascens (Merriam)

To the tourist these are "big chipmunks," but the plain backs and broad side-stripes, the stouter build, shorter ears, and less sprightly habits distinguish them from the true chipmunks. In fact, they are nearer to the ground squirrels, which they resemble in disposition and habits. During midsummer they are reddish brown over the head and sides and gray along the back between the stripes, but late in August they merge into their rusty gray winter coats, although retaining the broad side stripes.

They have a very general distribution over Yellowstone Park, but in some years are abundant and in others scarce. In August, 1894, I found them common through the round of the park roads and often very tame where they were picking up scattered grain from the roadside. In 1910, Birdseye reported these "tiger squirrels" abundant at Gardiner and from there to Swan Lake, and much tamer and more numerous than the chipmunks; and Cary found them abundant from Sylvan Pass to Mammoth Hot Springs and south through the three geyser basins and along the road to Snake River. In August, 1915, in covering a greater extent of the park than on any previous trip, I saw only two individuals, but in 1917 they were fairly common and generally tame.

One that I saw on September 16, between the canyon and Norris Basin, was not fully grown and still retained some of the summer brown over its head and shoulders. It had evidently been late in acquiring its supply of winter fat for hibernation and had come out on a bright sunny morning to look for a few more loads of seeds. It was sitting on a boulder by the side of the road and seemed so tame that I got off my horse and photographed it six feet from the lens as many times as I

wished, and could have shortened the distance had the focus of the camera permitted. It seemed sleepy as it blinked in the warm sunlight, but was so little disturbed by my presence that I finally rode off, leaving it sitting contentedly on the rock. Here, in the protection of the park, the naturally confiding natures of ground squirrels respond quickly to human advances, and they are among the gentlest of the animals, at some of



FIG. 31. Gray-mantled ground squirrel, incorrectly called chipmunk by many.

the camps and hotels coming readily to take food from one's hands.

They rarely climb trees and their homes are mainly in underground burrows, which enter the ground under logs or rocks or between narrow cracks that will admit no larger animals.

In food habits they are as omnivorous as the chipmunks, subsisting largely upon the seeds of a great variety of flowering plants and grasses and some pine and spruce cones that are cut off by the red squirrels. They are fond of any kind of scattered

grain that can be obtained along the roads and around camp sites, and often gather in considerable numbers at old camps, not only for grain, but for scraps of whatever food they can find, as bread, meat, cereals, fruit, and vegetables. The camp scraps are generally eaten as they are found, but the seeds that are not needed at once for food are tucked away in capacious cheek pouches until such time as they can be carried to the underground store houses and deposited for future use.

Just when these winter stores are used is not well known, as the squirrels become extremely fat, and in August or September, about the time of the first heavy frosts, they go into winter quarters for a half-year sleep in their warm underground nests. They are not seen again until the warm April days have partly removed the snow, when they emerge, sleepy and quiet, but still fat or in good condition. It is probably at this time, when other food is scarce or partly covered by snow, that their stores are of the greatest importance to them.

UINTA GROUND SQUIRREL

Citellus armatus (Kennicott)

These little, dark gray ground squirrels or picket-pins, often erroneously called gophers, are extremely abundant over all the valley country of the northern part of the park, mainly in Transition Zone, but often extending in open areas into the more elevated Canadian Zone. In 1894 I found them abundant at Cooke City and down Soda Butte Creek and Lamar River valleys, and throughout the Yellowstone Valley to Gardiner. In 1915 they were especially numerous in the valley about Yanceys and up over the open slopes of Specimen Ridge to at least eight thousand feet. They were abundant in Swan Lake and Willow Valley, and up the lower part of the valley of Fawn Creek, but in West Gallatin Valley no signs of them were seen until we were a little below the northwest corner of the park, when they were again common down to the lower basin. They were common at Gardiner and down the valley a little below,

but were not found below Sphinx, where the canyon narrows up with rocky walls. In September I found their burrows and runways numerous and conspicuous all through Willow Park, Hayden Valley, and in Norris Geyser Basin, where they had been in their dens for some time, though badgers were still digging them out for food. In July, 1910, Birdseye reported them as swarming around the Swan Lake camps and in August, Cary found a few still out between Sylvan Pass and Yellowstone Lake, but over most of the park they had then denned up for the winter, and he saw only their burrows and trails. In 1926 I found them at Nez Perce Creek, Old Faithful, Hayden Valley, and along the west side of Yellowstone River above the canyon. It is not improbable that they inhabit most if not all of the open areas in Yellowstone Park, but in this elevated region the summers are so short that the season of their activity gives scant time for tracing out their actual range.

Like most ground squirrels, they are restricted to open country, where grass and low vegetation furnish food and cover, and their numerous burrows are connected by well worn trails through the grass. They are often so common along the roadsides that their shrill piping and trilling are almost constantly heard, and they are frequently seen standing erect in the grass, their straight bodies and smooth heads giving much the appearance of a stake or some left-over picket pin. As danger approaches they drop to the ground and are lost in the tangle of grass or disappear down their ever ready burrows. Often where especially common they are bold and conspicuous, but they are such fat, toothsome morsels that their pursuers are legion, and as their numbers diminish they become extremely wary. Among so many natural enemies the presence of man is often their greatest protection. At the Swan Lake camp Birdseye reported them living under the buildings and the floors of the permanent tents, and in many places they are most numerous close to buildings and under walls and lumber piles. At Mammoth they are especially abundant and tame on the lawns.

A great part of their food consists of the seeds of grasses, but almost any seed or grain is eagerly accepted and much green vegetation also is eaten during the summer. Along the roads and around the camps they pick up scattered or waste grain and other food, and Birdseye reported them as visiting some of the camps for popcorn, dropped during evening festivities. For their size they consume great quantities of food, their stomachs usually



Photo by M. P. Skinner

FIG. 32. Uinta ground squirrel, or picket-pin; common in the open valleys along the stage roads.

being stuffed to the limit of their capacity. Some seeds and grain are carried away in their cheek pouches, apparently to be stored for future use, but their main dependence for winter is the great accumulation of fat that is found between the skin and body and throughout every possible cavity inside.

By the middle of August the old males, at least, are becoming so corpulent as to appear sleepy and stupid, and from this time until the first frosts the numbers seen become rapidly less as

they enter their underground nests and become torpid for the long winter hibernation. The young of the year are later in filling their skins with fat and some of them do not enter hibernation before the last of August. After this none is seen until late in March or some time in April, when they emerge, often through a layer of wet snow, and begin active life again. When they first appear they are usually well supplied with fat, but this is rapidly consumed when they become active again.

The mating season begins soon after they come out of winter quarters and large families of young are brought forth in the warm underground nests. The young begin to appear above ground about the first of June and while they grow rapidly through the short summer they are usually not fully grown when they enter hibernation in August. There is scant time for one litter a year, but the families are so large and the increase so rapid that a host of enemies are necessary to check overproduction.

Many species of hawks are attracted by them, and coyotes, foxes, bobcats, and badgers are constantly feasting upon them. Even bears occasionally dig them out. The badger, however, is their greatest enemy and probably does more than any other animal to hold their numbers in check. In places the big burrows where badgers have dug them out are almost as numerous as the burrows of the ground squirrels themselves. Even when the squirrels have hibernated the badgers still dig them out, feasting on them until the ground freezes hard and it is time for them to go into winter quarters themselves.

In the park these squirrels can do little damage unless they become so numerous as materially to affect the grazing needed for elk and other native animals. They add interest and variety to the park life and are sufficiently controlled by their natural enemies. Outside the park, however, they often do serious damage to crops on cultivated land or to closely grazed and valuable stock range. While it is necessary to control their numbers by artificial methods outside, it will probably never be so within

the park borders if a wise adjustment of predatory birds and mammals is maintained.

RICHARDSON'S GROUND SQUIRREL

Citellus richardsonii richardsonii (Sabine)

The fat yellow ground squirrels, also commonly called flicker-tails, picket-pins, and gophers, having a wide range over Montana, Dakota, and Alberta, are abundant along Yellowstone Valley from Livingston, Montana, up to Sphinx, just below the entrance to the park. They have been reported in the park, but I could find no trace of them at Gardiner nor anywhere within the park line. They look like small prairie-dogs and are closely related to them; but are smaller and instead of living in colonies or dog-towns are scattered over all the valley. They are often seen along both sides of the railroad sitting up straight as picket-pins on the watch for enemies, but more often are seen scampering for their burrows to escape real or imaginary dangers. At the entrance to their burrows they usually sit and wait to see if they are pursued, and if an enemy approaches disappear with a farewell flicker of the little bushy yellow tail, a habit that has given them one of their common names.

In grain-raising districts they cause heavy losses to the farmers but on wild land are merely one of the interesting animal features.

BLACK-TAILED PRAIRIE-DOG

Cynomys ludovicianus ludovicianus (Ord)

Prairie-dogs have been reported among the mammals occurring within Yellowstone National Park,⁹ but on very uncertain evidence. The only place where their known range approaches the park border is in Yellowstone Valley between Livingston and Gardiner. A careful search in all of the open valley about Gardiner, both above and below the park line, failed to reveal even a trace of old prairie-dog mounds, which are usually conspicuous

⁹ Ernest Thompson Seton, *Recreation*, p. 365, May, 1898; *Wild Animals at Home*, p. 222, 1913.

for many years after the animals have disappeared. From a little south of Livingston prairie-dogs are common along the valley bottom up about half-way to Gardiner or near the little station of Emigrant, on the west side of the river. It is not improbable that they extend farther up the valley on the other side of the river; but it is very improbable that they would ever get above the narrow gorge of Yankee Jim Canyon.

On leaving Livingston for Gardiner, one soon sees along the railroad scattered colonies of these fat little squirrels, for they are squirrels rather than dogs. In places they are numerous and again none is found for several miles. On a bright morning they may be seen from the train, digging up the short grass for their breakfast or sitting up on their mounds, singly on sentinel duty or in family parties, ready to dive out of sight at a moment's warning of danger. If the train is not too noisy their little *yap, yap, yap* can be heard as they sit and twinkle their stubby tails at passersby. Some of the colonies are close to the edge of grain fields, which means trouble for the colonists, if the farmer objects to their harvesting his crops. In fact many of the areas on which colonies were formerly located have been plowed up and the evicted prairie-dogs are often seen wandering about over the black furrows trying to find their old homes.

Over a wide range on the Great Plains they have been systematically destroyed to conserve the range grasses for domestic stock and to protect the farmers' crops, but an occasional colony could well be left for the enjoyment of future generations. It may some day be necessary to protect a colony on some refuge to prevent the extermination of the species.

GOLDEN-MANTLED MARMOT; WOODCHUCK

Marmota flaviventris nosophora Howell

The woodchucks, rockchucks, marmots, or ground-hogs, as variously called, are among the familiar animals of Yellowstone Park. In some individuals the golden mantle is very conspicuous and of a rich dull orange color, in striking contrast to the

dark head and tail and white nose. In others the general coat is much darker and sometimes a dull dark brown almost throughout, but usually the yellow shows on neck and sides. While related to the prairie-dogs and ground squirrels, they are much larger than either and, unless alarmed, are of a rather slow and dignified bearing.

About Gardiner, Mammoth Hot Springs, Yanceys, Swan Lake Camp, Spring Creek Canyon, and along the canyon of the Yellowstone, they are abundant and very tame. Throughout the park they are generally found on extensive slopes of broken rock or on rocky cliffs, in which they can find safe retreats. They are so slow, so fat, and so palatable that their varying success in applying the principles of "safety first" has largely determined their distribution. Unlike most mammals, they have adapted themselves to all altitudes from the valley bottoms in Upper Sonoran Zone to the crests of mountain ranges at timberline and even slightly above, wherever extensive rock slides offer them the fortifications necessary for their existence. Without any appreciable variation the species ranges through four life zones, Upper Sonoran, Transition, Canadian, and Hudsonian. While numerous locally in the park their actual distribution does not cover much of the ground, as they are almost entirely absent from the densely forested areas and from open park or meadow country, except where cliffs, rock slides, or log jams afford them protection within these areas.

Like other park animals they have learned that the presence of man affords them protection by keeping away their natural enemies and have taken advantage of this condition to gather about the hotels, camps, and other frequented spots. At Mammoth Hot Springs they will sit up and watch the tourists passing along the trails only a rod away, with no sign of fear, and at a friendly gesture will slowly approach an extended hand for such proffered dainties as peanuts, crackers, popcorn, or candy. At Yanceys, in 1915, when frightened by discovering me, a dozen of them would often run back from the edge of the

meadow, where they were feeding, to their fortified homes in the neighboring rock slide, but safely there they would let me walk up to within ten feet for photographs before diving into the cavities among the broken rocks. Birdseye in 1910 reported them along the road from Gardiner to the Grand Canyon but as most abundant at the Swan Lake Camps, where they vied with the ground squirrels in visiting garbage pails, gleaning popcorn and other scraps from the ground, and seeking com-



Photo by Lee Phillips

FIG. 33. Woodchuck at Yellowstone Canyon. August 2, 1926.

fortable homes under the tent floors. The same year Cary reported them as exceptionally tame near the Canyon Hotel and about Yellowstone Falls, where they would often allow one to walk up within three feet of them.

On my first visit to the park in 1894 they were not noticeably tamer than in outside areas, but since then they have gradually lost much of their timidity and where most in touch with people, as at Mammoth, the canyon, and Old Faithful, they have become exceedingly gentle and confiding. At Old Faithful Camp in 1926 they were living in the rocks along the creek and under the

tent cabins. One old mother and four half-grown young came regularly to my doorstep every morning for crackers and rolled oats and when the door was left open they would come into the cabin, take crackers from my hand, sit up to eat them and then beg for more. After enjoying such dainties they would go out in the meadows and stuff themselves with clover and other good wholesome vegetation until their sides bulged out and they fairly waddled with the fat that was to carry them through a long cold winter.

At Yellowstone Canyon, around the canyon hotel camp and ranger station, big fat woodchucks waddle along the trails and sit on rocks or logs watching the passersby, expecting and often receiving dainty morsels of food from friendly hands.

When not eating they are generally seen sitting on top of some large rock or on a log or stump, where they command a good view of the surrounding country. Often while several are out feeding one stands guard, and a single loud chirp or short sharp whistle sends them all scurrying for cover. They do not often climb trees but they can climb and are often seen sitting on stumps or running over logs. Near Yanceys a family of four or five half-grown young were having a game of rough and tumble over a big log, up and down the stump, and on the ground, where two would clinch and roll and scuffle in a furry ball that suggested a lively cat fight. The adults, however, are very serious and life for them seems one strenuous effort to get food and to escape from enemies until they are fat enough to go into winter quarters.

Their food consists largely of green vegetation, especially in spring and early summer, including grass, clover, and a great variety of small plants, flowers, and some green seeds. Late in summer they add to this diet the ripening seeds of grasses and other plants with which their large stomachs are usually found distended.

In 1915, up to late in July, woodchucks were still active even at high altitudes, but before the first of September they had

mostly disappeared into their underground nests, not to reappear until the warm days late in March or early in April. In 1914, Skinner reported them scarce after August 20, and the last two as seen on August 29 and September 19. In 1917, they were common at the canyon on September 11, and one was seen in the Golden Gate on September 13. Unless a sudden cold wave comes early they do not all retire at the same



Photo by A. H. Howell,

FIG. 34. Woodchuck from the Bitterroot Valley, Montana, the same subspecies as that in the Yellowstone Park. April 3, 1910.

time. The adults, and especially the adult males, become fat earlier and are the first to enter hibernation; while the late young of the year, which are not yet fully grown, do not acquire the requisite quantity of fat until late in the season, and often come out again on warm days to gather a little more food to increase their supply of winter fat. Their dens are usually in burrows among the rocks or in caves or crevices that reach well down beneath where warm nests are prepared for the long winter sleep.

The young, numbering generally four to six in a family, are born in May, and by the first of July are half-grown and out gathering their own food, though they are still under the watchful care of their mothers.

Woodchucks are valiant fighters and will always give battle if cornered, but their short legs are such a handicap that their only hope of escape from their larger enemies lies in constant watchfulness and keeping within reach of safe retreats. Bears, badgers, coyotes, wolves, lynxes, eagles, and some of the larger hawks are their principal enemies within the park, but here, where they are free from the greater danger of dogs and rifles, they hold their own and are more numerous than in most parts of the country. While in agricultural areas they do considerable damage and their numbers must be kept down for the protection of crops, there is nothing in the park for them to injure and they afford the much needed opportunity for the public to get nearer than rifle or shotgun range to the wild creatures of the earth, which have many of our own virtues and few of our vices.

GRAY BUSHY-TAILED WOOD RAT

Neotoma cinerea cinerea (Ord)

The large gray wood rats, or pack rats, with their wide, almost squirrel-like tails, their large, bright eyes, big ears, and long mustaches, are among the interesting and attractive denizens of the park. They are common in the low country along the northern border, and specimens have been taken at Gardiner and on Lamar River; but those of the higher levels probably all belong to the slightly darker subspecies, *orolestes*. The gray wood rats seem to occur mainly in Transition Zone and to prefer cliffs and rocky places in the open country. At Mammoth Hot Springs their signs are seen along the rocks and cliffs and their characteristic long, black pellets are scattered over the steps down in the Devils Kitchen. The white streaks that they leave on the rocks wherever they live are conspicuous at Gardiner and along the Gardiner River, at Yanceys, and the lower end

of Yellowstone Canyon, in the rocky narrows along Lamar River and in the cliffs near its mouth.

While few animals have furnished a basis for so much misconception and fiction as the wood rats, the plain truth about them is sufficiently unusual and interesting. They are the original cliff dwellers and many of their strongholds have been occupied for ages, as shown by accumulations of old building material, remnants of food supplies, and, in dry and protected places, accumulations of old excreta that have become like hardened masses of asphalt. The long black pellets of excrement, so characteristic of the genus, are mainly deposited in some definite place at a distance from the nest, but they are also found scattered over the ground outside or over the rocks where the rats travel. The white streaks that they leave on the rocks and cliffs are made by their urine, which is thick and milky with calcareous matter, and as it hardens leaves a white rock-like deposit that remains for years.

They do not build houses in the open or in the woods, as do some of the southern wood rats, but wander more or less from their rocky fortresses and frequently discover and take possession of some old camp or cabin in the woods. A barn, shed, or other artificial structure seems to appeal strongly to these natural builders. Self protection appears to be their aim in building, but the habit has been so long established that they must needs build although there may be no occasion for it. Even in deep caves, where narrow nooks and corners are admirably adapted to their wants, they still gather building material and barricade their doorways, or, if these do not need barricading, pile up sticks, stones, bones, and every portable object they can procure, as near to the doorways as they can. Along the cliffs their heaps of building material are often used to good advantage in closing the entrance to a nest cavity so that no larger animal can intrude, and this seems to be their prime motive in all their accumulations. Sometimes an old log or hollow tree is selected as a home and a heap of rubbish piled

up to close the entrance to its cavity or merely to cover the entrance of their burrows into the ground beneath. In this north country, where thorns are scarce, their chief building materials are stones, sticks, chips, bark, bones, bits of glass, broken crockery and pieces of metal.



FIG. 35. Wood rat house in cleft of rock wall near Old Faithful, with white markings on the points of rocks about the den.

In the barricaded chambers of the rocks, where their real homes are, their nests usually occupy the smaller cavities and each bed is a cup-shaped nest of soft grass, moss, or plant fibers, a little larger than a robin's nest and of about the same form. These sleeping quarters are always clean and fresh, and while de-

posits of food may be near-by, even the food refuse is carried out and used as building material.

Wood rats are good climbers and gather much of their food from the branches of the juniper and other forest trees, and climb over the rocks and along little grooves or ridges from point to point on the face of high cliffs. They are strictly nocturnal in their habits, and are rarely seen alive except as they are caught in traps, either for study purposes or to stop the mischief they do around human habitations. In camps and mountain cabins they are often heard at night as they scamper noisily from place to place or drag their construction material over the floors and roofs. This habit of gathering supplies has led to the many wild stories in circulation regarding their commercial dispositions, for they are commonly credited with bringing one object and exchanging it for another, and often are spoken of as "trade rats." This exchange may easily take place if, when one is carrying a stone, he happens to find a bone or pocket knife that appeals to him as better building material, and drops one to pick up the other. The fact that they gather up anything of a size convenient for carrying is so frequently demonstrated as to be beyond question. Knives, forks, spoons, and other small articles are apparently considered valuable discoveries and almost invariably appropriated. The mouse traps set by a collector are also garnered by any chance wood rat that comes along, unless the snapping of the trap pinches him or scares him away.

While almost omnivorous in habits, wood rats subsist mainly upon vegetable matter, seeds, berries, and green vegetation. On Lamar River they had been gathering juniper twigs and berries and carrying them to their storehouses in the cliff, where empty juniper seeds and the chaff and shells from seeds of numerous plants were scattered about their feeding spots. Many old cones of Douglas spruce and limber pine were found about their feeding grounds, and our camp was visited for such scraps as were thrown out or any food supplies that could be obtained.

They are fond of prunes, peanuts, bacon, any cooked meat, bread, or pancakes, rolled oats, or any kind of grain. The contents of their stomachs usually show a mass of starchy material from neatly shelled seeds or grain with some green vegetation and other matter not easily identified.

Wood rats rarely show any trace of fat and are active throughout the year. Some food supplies are laid up for winter, both seeds and green foliage well cured in the fall. In winter their



Photo by Clarence Birdseye

FIG. 36. Gray bushy-tailed wood rat in captivity. Bitterroot Valley, Montana.

fur becomes long, full, and soft, and their big bushy tails quite squirrel-like. Their winter habits have not been thoroughly studied, however, and their home life is not well known.

Small families of two to four young are born at irregular times during the summer and as young of various ages are often caught at the same time it is possible that more than one litter is sometimes raised during the year. It would seem almost necessary that more than four young should be raised in a season to keep up the supply, for their enemies are legion. The fact that these wood rats are never numerous is probably due to their enemies, among which are bobcats, coyotes, weasels, mar-

tens, skunks, and owls. Bobcats and owls are especially thorough in their search among rocks and crevices where wood rats may occur, and in cliffs where the owls make their own homes wood rats are apt to be scarce.

They are fond of testing any kind of food or any new material and will often cut straps or strings from harnesses and saddles, or cut open grain sacks and packages of food or camp supplies that they can reach. One may do serious damage in a single night and if several were to remain in a stable or other building they would often cause great loss.

Fortunately, however, they are easily caught in any kind of rat traps and can be baited with almost any kind of food. A bit of fried bacon on the trigger and rolled oats scattered over it will generally attract them to the trap before they do any serious damage. There is little trouble in keeping traps set where they are likely to appear, and in camps that are left for winter a number of kill-em-quick traps can be left set to dispose of the wood rats as they enter. Steel traps are less effective and much more cruel than those in which a strong spring falls across the neck or back of the animal and kills it almost instantly. These can be bought at a grocery or hardware store and cost less than steel traps.

But for their name wood rats might be considered valuable food animals, as their habits are exemplary and their flesh is tender and well flavored. It is doubtful, however, if the unscientific mind can overcome its aversion to the inappropriate name of rat, which has become firmly attached to them.

COLORADO BUSHY-TAILED WOOD RAT

Neotoma cinerea orolestes Merriam

The Colorado form is a slightly darker variety of the bushy-tailed wood rat group, inhabiting the mountains and higher levels of Yellowstone Park, as shown by specimens collected in the Upper Geyser Basin and along the eastern and southern margins of the park. Cary found signs of them in a rock slide

on Sylvan Pass and also in the cliffs south of Lewis Lake, and they are common along Snake and Lewis rivers and in the Obsidian Cliffs along Gibbon and Firehole rivers, in the Upper Geyser Basin, in Spring Creek Canyon, about Natural Bridge, and near the camp at Yellowstone Lake. The range of the species farther south is mainly in Transition Zone, but in many places they extend higher up into the rocky slopes of Canadian Zone. They often wander from their rocky cliffs through the great windfalls that follow old fires in the timber and occasionally visit camps or hotels in almost any part of the park. In appearance they are very similar and in habits practically identical with the gray bushy-tailed wood rat.

HOUSE MOUSE

Mus musculus Linnaeus

The common house mouse, originally introduced from European countries, has spread over almost all settled parts of this country. House mice are abundant and troublesome in houses and stables at Gardiner and Mammoth Hot Springs and may be found at any of the larger hotels and permanent camps in the park. Carried from place to place in boxes of goods or loads of grain or hay, they have a way of appearing at unaccountable times and places. A few mouse traps would dispose of them much more effectively than any number of cats.

AUDUBON'S GRASSHOPPER MOUSE

Onychomys leucogaster missouriensis (Audubon and Bachman)

Grasshopper mice resemble the more common white-footed mice but are stouter, with smaller ears and shorter, thicker, more tapering tails. They have been reported from the park but no specimens have been collected and the only evidence of their presence is that they are common lower down the Yellowstone Valley in country similar to that around Gardiner,

Grasshopper mice generally live among scattered sagebrush and occupy any old burrows that are convenient. Although true

rodents, their food consists largely of insects, of which grasshoppers form a conspicuous part. They also eat any kind of meat and a small quantity of seeds and grain. They are gentle little animals and make interesting pets. Their call, frequently heard at night, is a delicate prolonged whistle, so thin and shrill that it might be mistaken for the note of some insect.

WHITE-FOOTED MOUSE

Peromyscus maniculatus artemisiae (Rhoads)

The white-footed mice of this region are pretty little animals with large ears and bright eyes, with tails about as long as their bodies, with gray or brown upper parts and with white feet and lower parts. They are very different from the house mice in appearance as well as habits. They are common throughout the forests, among rocks, in meadows, and in open grassy places, living in hollow trees or logs, among broken rocks or in burrows in the open, and often enter newly built camps or houses. They are expert climbers and will take refuge in the top of a tree or down the nearest gopher burrow, or run swiftly in long bounding leaps to escape their enemies. They are strictly nocturnal and rarely seen in the daytime unless disturbed in their nests, but at night their little bare feet often patter over the canvas cover of a camper's bed or sometimes over his face in a startling but perfectly harmless way. They sometimes get into provisions at night and do some slight mischief, but a few mouse traps set around camp will usually prevent any serious trouble and show what has been making the tiny tracks in the dust around the campfire. The tin-lined cupboard and "grub box" of the forest ranger's cabin saves trouble in any permanent camp in the woods and leaves these interesting little sprites the happy freedom they deserve.

ROCKY MOUNTAIN LEMMING MOUSE

Phenacomys intermedius intermedius Merriam

A single specimen of this little short-tailed gray ground mouse was taken near Tower Falls in 1894, and as the species is found

over the surrounding mountain country, it is probably scattered over much of the park. While never very numerous, a few get into the collectors' traps set for other ground mice. They are generally caught in grassy places on the mountain slopes where they live in little burrows in the ground and sometimes leave a slight trail from one burrow to another much as do the meadow mice. They eat the stems, blades, and seeds of green grass and other plants, the remains of which are left scattered about their doorways.

RED-BACKED MOUSE

*Evotomys*¹⁶ *gapperi galei* Merriam

These bricky brown-backed mice have been taken in the park and probably occupy all of its forested area as they do the mountains of the surrounding country. They are obscure little animals, plainly colored and rarely seen except as caught in traps set under the edge of old logs in the woods or thickets, but often are abundant in favorite spots. Like the meadow mice, they live in burrows in the ground and often make trails from one burrow to another, while keeping hidden under the cover of green grass and other vegetation. Their food in summer consists of green plant stems and leaves, and in winter of such green vegetation as can be found on the surface of the ground under the snow, besides the bark from roots and stems of such shrubs and small trees as come within reach. They are active all winter and the deeper the snow the safer and warmer they are under its great white cover.

SAGUACHE MEADOW MOUSE

Microtus pennsylvanicus modestus (Baird)

Two specimens of these medium-sized and blackish meadow mice were taken by Lieut. Wirt Robinson at Mammoth Hot Springs in August, 1907, and a specimen was recorded from

¹⁶ Now called *Clethrionomys*.

the Lower Geyser Basin in my revision of the genus *Microtus* (*North American Fauna*, no. 17, 1900). In 1926 I found them common at Nez Perce Creek, Old Faithful, and Shoshone Lake. As these mice have a wide range over the Rocky Mountain region farther south they are probably scattered over the meadows of the park, although this is on the northern border of their known range. They are the western representatives of the common meadow mouse of the eastern states and are generally found in marshes and meadows in open country. In cultivated areas they become abundant and do serious damage to many farm crops, but in the park they can do comparatively little harm and are a useful source of food supply for carnivorous birds and mammals.

LITTLE MOUNTAIN MEADOW MOUSE

Microtus nanus nanus (Merriam)

The little dull gray and rather short-tailed mountain meadow mice were first made known as residents of the park through a specimen picked up by Colonel Theodore Roosevelt in the Lower Geyser Basin in 1903 and sent to the U. S. Biological Survey for identification. In 1915, I found them abundant along Lamar River and Mist Creek and saw their characteristic little roads and burrows under the grass of meadows and upland slopes over a great part of the park, from the lower edge of Canadian Zone up to timberline. In 1917, they were found in great abundance near the outlet of Yellowstone Lake and in 1926 specimens were taken at Old Faithful, Shoshone Lake, Lewis and Heart lakes, on Fawn Creek and the Upper Yellowstone.

They appear to be the most abundant and generally distributed meadow mice of the park, as they occupy both the meadows and the dry upland slopes, where there is a good cover of grass. On Mist Creek I saw one dive into a little cold creek, swim across under water, and disappear into the bank on the other side. In other places they were far from water on

dry slopes, where their tiny round burrows perforated the ground and little roadways led from one to another or off through the grass, where cut stems and leaves showed on what they had been feeding.

The summer nests are all in underground chambers and in these soft grassy balls the families of tiny naked young are born and nursed until half-grown and large enough to get out and cut grass for themselves. Apparently several litters are raised in a season, as young of all sizes are found at the same time, and females taken for specimens during the summer contain six to ten embryos at any time up to the beginning of cold weather.

The winter has no terrors for these little animals for under the cover of deep snow they can visit back and forth among their grassy nest balls and find abundance of food among the green stems and roots of plants, while their dense furry coats insure warmth and comfort, no matter how the cold storms rage above the snowy blanket. But above all they enjoy a brief respite from their enemies, hawks, owls, coyotes, foxes, bobcats, badgers, and weasels, that during the summer are snapping them up or digging them out at every turn. But for these enemies they would quickly multiply to such numbers that no green thing would remain as food for other and more useful animals.

At the same time they have a value rarely appreciated by man as food for numerous birds and mammals, the bread and butter, as it were, of jays, crows, ravens, hawks, and owls, as well as of weasels, minks, martens, skunks, badgers, foxes, coyotes, and even bears. As Seton¹⁰ has well said "The mouse millions are the boats especially designed to bring food over from the Mainland of Grass to the Island of Carnivores." Indeed the flesheaters are far more dependent on mice than they are even on the great ruminants. These may furnish an occasional meal but mice are the ever present and reliable hunger-

¹⁰ Seton, Ernest Thompson. *Life Histories of Northern Animals*, vol. 1, p. 522, 1909.

stay and without them our carnivorous birds and beasts might speedily cease to exist.

ROCKY MOUNTAIN MEADOW MOUSE

Microtus mordax mordax Merriam

Specimens of the long-tailed, light gray, Rocky Mountain meadow mice have been taken near Tower Falls, Mammoth Hot Springs, and in Snow Pass, and as they are abundant along practically every stream and in every meadow throughout the mountain region surrounding the park, they are undoubtedly common also over much of its area. They are both meadow and stream mice, being equally at home on dry ground or in the icy water of the mountain creeks. They find congenial homes in and around marshy places or along the banks of grass-bordered mountain streams, where their burrows often perforate the banks in great numbers, some opening out above the surface of the water and some below. Their numerous little trails, or roadways, often run through the shallow water or end abruptly on one creek bank and begin again on the other. Their dense fur is ample protection from cold and wet and their soft warm nests in dry cavities of the creek banks, where the young are born and reared, are safe and comfortable homes. Their winter nests on the surface of the ground under the cover of deep snow are also comfortable homes, and from them the little tunnels extend in all directions over the surface of the ground to the green plant stems, roots, and bark of such plants as the occupants like best for food.

A great part of their food for both winter and summer consists of green grass, but numerous other plants are eaten, and under the winter snow they often so strip the bark from the bases of bushes and small trees that they are killed. In winter the little weasel is almost their only important enemy, but when the ground is free from snow they are the desired prey of every owl, hawk, crow, and jay, and are systematically hunted by every fox, coyote, bear, and badger that comes along. But for these

natural enemies their numbers might become so great as to destroy the grazing for game and stock.

LARGE-FOOTED MEADOW MOUSE

Microtus richardsoni macropus Merriam

Specimens of the large, dark gray, and rather long-tailed meadow mouse have been taken at Heart Lake and near both the northwest and southwest corners of the park, and their characteristic large burrows and wide trails are seen along many of the streams in the western part of the park. Their runways are almost invariably found close to water, generally along the cold mountain streams where they lead in and out of the water. The mice may occasionally be seen swimming from one side to the other in the manner of muskrats, often diving and swimming across the streams below the surface without exposing themselves to lurking enemies.

They feed on grass stems along the banks or in wet marshes and are rarely found far from water. Like other meadow mice they nest in hollow cavities in the banks and make winter nests, great balls of dry grass, on the surface of the ground, where they live under the cover of deep snows in comparative safety and comfort. They do not become fat in fall, nor hibernate, nor lay up stores of food for winter, and as the green stems and tender shoots and roots of marsh plants are just as accessible under the snow as at any other time there is no lack of their favorite food throughout the year. When the snow disappears in spring a network of trails shows how their tunnels and roads cover the surface of the meadows, and the scattered stems and bits of food indicate how well they have fared.

They are prolific breeders and but for numerous enemies would soon increase so as to ruin the meadows. Hawks and owls, weasels and foxes feast upon them and congregate where they are most abundant, and thus their numbers are kept within practically harmless bounds.

MOUNTAIN MUSKRAT

Ondatra zibethica osoyoosensis (Lord)

The rushing streams and clean cold lakes of the park are not well suited to the habits of muskrats, but in the quiet sections of some streams and in many of the shallow grassy bordered lakes and ponds they find congenial homes, practically throughout the whole park region. They are common on marshy shores of Shoshone Lake, Heart Lake, and along the upper Yellowstone River. A few live in the edges of Yellowstone Lake and in the still water at the outlet. Skinner reports them in the larger Twin Pond and in Soda Butte Creek, and I saw a house in a pond near Slough Creek and one in the beaver pond on Lava Creek. At Gardiner they burrow in the banks of irrigation ditches, and in the Ice Pond near Mammoth they live in the banks and in the beaver houses. In Swan Lake marsh there are several very good muskrat houses close to the main stage road, where tourists can see them in passing and pedestrians can stop and, if not afraid of getting their feet wet, examine and photograph them. These houses resemble the little beaver houses seen along Obsidian Creek, but are smaller and more conical and are made of grass, turf, and mud instead of sticks and mud.

The muskrats are in part diurnal and can be watched at their feeding and building operations to best advantage either in early morning or late afternoon, when if not worried or alarmed they are always active, gathering their food of roots and green plants along the water margins and swimming rapidly from place to place at the points of pretty V-shaped ripples, or in silvery air-bubble diving suits going long distances under water. With a quick shake of their brown furry coats they climb onto the banks and in a moment all but their webbed feet and flattened rudder-tails are dry.

Their homes are often in the banks of streams, where large chambers hollowed out for the nest are entered by submerged doorways, but where suitable banks are not available, houses are built in the marshes or shallow water with thick walls and

under-water entrances. In autumn the houses are rebuilt with fresh sods and mud and heavy walls for the cold winter. Here these happy fur bearers are locked under the ice for many months, in comfortable quarters, with free access to all the submerged vegetation of the ponds or lakes.

Their food consists of roots, bulbs, and tubers, and the tender base of numerous marsh and water plants. The many kinds of sedges afford a great part of their supply but tender grasses and clovers, the roots and stems of water lilies, and many floating pondweeds are eaten. They apparently eat some mussels from the lake bottoms but otherwise seem to be exclusively vegetarian in taste. They do not store food for winter but find abundance of the choicest kinds in the water or along the banks under the ice and when the lakes are well frozen they are free to make long excursions in search of food.



FIG. 37. Muskrat house in the marsh at north end of Swan Lake, close to the stage road by which tourists enter the park.

The mating season is in early spring and the young are born in the houses or bank nests in May or June. At these high altitudes it is doubtful if more than one or two litters of young are raised in a season, but generally muskrats are prolific breeders. Usually there are six or eight young to a litter and in one case I found thirteen embryos in a female high up in the mountains of Montana. There is some evidence that the litters are larger and fewer in the northern latitudes or higher altitudes



Courtesy of U. S. Biological Survey

FIG. 38. Muskrat at home.

than in the lower and milder zones, where breeding activities continue for most of the year.

In the park, where no trapping is allowed, the limitation on abundance of muskrats is determined by either food supply or natural enemies. Apparently the food supply is ample for a much larger muskrat population but their greatest enemy, the mink, is generally present in sufficient numbers to keep down their increase to a minimum. Minks are especially destructive during the winter when they get under the ice and corner the muskrats in their houses, often cleaning out a whole colony before leaving for another lake or pond. In summer the large

owls also capture many, especially of the young, and the coyotes undoubtedly get a few, as they do in other localities.

But even with many enemies to guard against, the muskrats in the park are noticeably less wary of man than in outside areas. At Heart Lake, when the Sierra Club party, numbering two hundred and fifty people, was camped on the shore, several came out during the evening and swam back and forth close to their campfire, apparently being attracted by the voices and music or else by the light of the fire. They even came up on the beach within a few feet of some of the people.

At the present time the muskrat is rated as the most valuable native fur bearing animal of North America. This value of some twelve million dollars a year is due, not to the high price of individual skins, but to the great number of them taken over almost the whole continent from Louisiana to Alaska. The rapidly growing industry of fur farming is making a study of muskrat habits of great importance and every item of reliable information on their mode of life or social psychology is eagerly welcomed by a large number of practical people. The inadequacy of our knowledge of animals so long and supposedly well known is shamefully apparent to those who know them best. The mere fact that tons of muskrat meat are thrown away every year when, under some other name, it might be counted as a choice and delicious game, is evidence of our general ignorance regarding such matters.

MISSOURI RIVER BEAVER

Castor canadensis missouriensis Bailey

In Yellowstone Park north of the Continental Divide the beavers probably all belong to this dull-brown form of the Missouri River drainage, as do all those examined from the Yellowstone Valley. From south of the Continental Divide in streams flowing into Snake River and eventually into the Columbia they should be the Pacific beaver (*Castor canadensis pacificus* Rhoads), of the Columbia River drainage, but no speci-

mens are available for examination from the southern part of the park.

Beavers are found along almost every stream in Yellowstone Park and in many places their houses and dams are conspicuous from the main automobile roads. There are better opportunities for close study of their habits, however, along the secluded small streams or ponds where colonies are found. During the early morning hours or just at dusk in the evening they may generally be seen swimming about or working on their houses and dams or cutting trees or bushes for food and building material. In places where they have become accustomed to man they show little fear and are one of the great attractions to numerous visitors in the park.

The old houses that have been added to year after year become very large, sometimes twenty or thirty feet across, reaching five or six feet above the surface of the water. They are strongly built of sticks laid criss-cross and cemented with mud, a type of construction proof against all enemies except man. The nest chambers just above the water level inside are entered from beneath the houses by submerged doorways.

The beaver dams are constructed in the same manner, of sticks laid down at all angles and covered with mud or clay from the bottom of the pond above them. At first a new dam is rough and porous and considerable water escapes through the interstices, but in time when the mud settles around the sticks and they become firmly imbedded, the whole structure becomes solid and wonderfully strong and durable. Generally the construction of the dam precedes that of the house and only when a sufficient depth of water is obtained to insure a safe supply throughout the year is the house begun. Small ponds that will dry up or freeze solid in winter are soon abandoned but, where there is any possibility of making a large pond, the dams are persistently built up by one generation of beavers after another until some fair-sized lakes are formed. Beaver architecture showing the progress from the beginning of new dams and

houses to the perfect structures, together with the well preserved remains of older and more numerous colonies, may be studied to good advantage in the park.

The habits of the beavers are a never exhausted source of interest, including methods of building, of digging canals for the transportation of building material and food, of towing and rafting timber, and above all of cutting down and trans-



FIG. 39. Beaver dam and house and pond on a branch of Mountain Creek, southeast of Yellowstone Lake, August, 1915.

porting trees for building material and food. Fortunately the trees that they cut are mainly willow and aspen, which have little value for other purposes. The bark from the trees serves chiefly as winter food and the trunks and branches are used for constructing dams and houses. In summer beavers feed largely upon green vegetation and roots from the shores of their streams and ponds, but some bark is eaten at all seasons, where it can be conveniently obtained.

The four to six young are born and nursed in the houses or

in bank chambers, where high banks are available along the streams and ponds. Their first glimpse of daylight and sky comes only when they are old enough to make the long underwater passage from their nest to the surface of the open water, but before they are half-grown they are at work with the rest of the colony, gathering their own food and helping to build strong dams and warm houses and store up food against the long cold winter.



FIG. 40. Yellowstone Park beavers in National Zoölogical Park at Washington, D.C., Winter of 1909.

The quest of beaver fur led the first daring trapper explorers into the region now known as Yellowstone Park and, before the importance of protecting some of our wild life became apparent, most of the beavers were trapped and sold for fur. In recent years under careful protection they have increased and now are again well established in most of the waters of the park. On account of the extensive herds of elk, which keep down the young aspen growth over most of the park, there is not an abundant food supply for a large number of beavers, perhaps for not many more than are now present. As their numbers increase some of the animals go down the main streams

into adjoining states so that there is no danger of overcrowding or injuring their range in the park.

Beaver farming is a slowly developing industry over some parts of the country but generally the forms with darkest fur are sought for breeding stock by those engaging in the business. The beavers in the park are not of the darkest or most valuable type for fur and their greatest value lies in the interest and pleasure they afford each year to thousands of visitors.

YELLOW-HAIRED PORCUPINE

Erethizon epixanthum epixanthum Brandt

Porcupines occur all over the park, as shown by their characteristic gnawings on trees, but the animals themselves are not often seen. Occasionally an individual may be met with as it follows a trail, leaving oval granular tracks in the dust and scratchy marks where its tail has dragged; or one may be seen toward evening in the open meadows, nibbling the green plants in its way. They are slow, short-sighted, and short-legged animals that can be safely followed and examined when they bristle up and stand on the defensive, if one keeps well beyond reach of the quick savage blows of their short, powerful and very spiny tails. They do not throw their quills, but a blow of the tail will drive the quills through heavy clothing or leather and deep into the flesh with very painful results.

Occasionally a porcupine may be seen well up in a tree, sitting on a branch or close against the trunk, where with big chisel-like incisors he scrapes off mouthfuls of green bark, leaving large patches on the trunk or branches with the bare white wood uncovered. Sometimes extensive patches are thus denuded of bark, and if a trunk is completely girdled the tree generally dies. Most of the injury to trees is done in winter when green food is not available, but the old scars remain for years and often seriously impair the health and growth of the tree.

Porcupines are usually solitary, except in the mating season or when the one young is still following its mother. They do not hi-

berate, as their winter food is always abundant in a forested area, and they seem to enjoy the coldest weather seated in breezy tree tops well above the snow. When the snow is soft they will sometimes remain for a considerable time in one tree, much to its detriment. On crusted snow, however, they move freely from tree to tree and from their feeding trees to their dens among

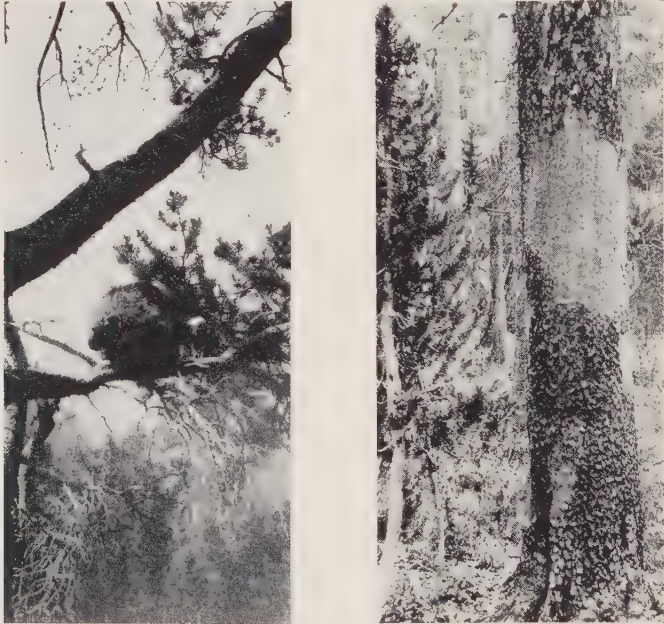


FIG. 41. A thirty-three-pound porcupine at Yellowstone Canyon and a lodgepole pine peeled by porcupine.

rocks, in cavities under logs or fallen tree tops, or under cover of dense brush.

Their enemies are not numerous but some of the larger carnivores are said to remove them successfully from their spiny coats and the hand of man is generally against them for the damage they do to the forests. Their limited numbers in the park, however, cause no noticeable loss of valuable timber and only add a unique and interesting animal to the fauna of the region.

Their heavy bodies and short legs render escape from most of their enemies impossible and flight useless, unless they are close to rocky cover or friendly tree trunks. Generally they stand on the defensive, well bristled up, awaiting the attack of an enemy, and thus are easily captured. By rolling one over and holding it on its back you can grasp both of its hind feet in one hand so that only the unarmed underside of its tail can strike your arm. In this way it can be lifted and safely carried for a short time until the hand becomes tired. Another way is to loop a string around one hind foot above the heel, when the captive may be driven slowly where you wish. But the simplest method of handling a porcupine is to take a light box or carton, put it quickly down over him, and when he has become quiet, tip the box and scoop him up with a sideways motion and keep him in the box. A thin board can be slipped under the box before it is turned right side up, then box and porcupine can be lifted and carried away. Once captured, they are easily handled and caged or kept temporarily in captivity for study and observation. One recently captured can be released from his box on a table and if not frightened can be approached with slow quiet motions and a soft voice until you can stroke his forehead and finally his back. It may never be safe to touch his tail or the lower part of his back or sides as the reflex motions of self defense are quick and involuntary, but with careful handling one can be tamed in a short time so he will welcome friendly attentions and gladly take food from your hand. With full confidence won, a porcupine makes a most interesting pet, though one not gifted with a high order of intelligence.

ROCKY MOUNTAIN JUMPING MICE

Zapus princeps princeps Allen

Specimens of these long-tailed jumping mice or, as often called, kangaroo mice, have been taken near the head of Mist Creek, and others were seen there and on the head of Fawn Creek. Others were taken at Old Faithful, Shoshone Lake,

Heart Lake, and Yellowstone Lake. The grass stems that they had cut were noted at many other localities and they are evidently common over most of the park, or at least in all of its Canadian Zone area. They live generally in the meadows and grassy parks and their long hind legs and feet enable them to reach up and cut the grass stems in longer sections than do the short-legged meadow mice or white-footed mice. Little heaps of grass stems four or five inches long indicate their feeding grounds. The tall seed-laden stems are cut off at the bottom and drawn down section by section until the seeds are reached, and



FIG. 42. Jumping mouse. A captive photographed in Bitterroot Valley by C. Birdseye.

these are neatly eaten while held in the tiny hands. The stomachs of specimens collected contained only the clean white starch of such little seeds.

In summer the mice live in nests, or hollow balls of grass blades and soft fibers, on the surface of the ground. They are often frightened from these and go bounding away in a few long leaps through the grass and then as suddenly stop and sit still. If closely watched and cautiously followed, they usually may be caught by a quick motion of the hand and examined without injury to mouse or man. They are timid and gentle and if properly handled rarely bite or struggle to escape.

In early autumn they become very fat and with the first frosty nights go into their warm nests underground where they hibernate through the long cold winter. Well below the frost line in the even temperature of the moist earth, they sleep curled up in a ball with the nose pressed into the middle of the belly, tail coiled around under them, and hind feet over their shoulders, resting on the belly and top of the head, with the back up, in an almost perfect ball. Given similar conditions and kept at a temperature of about forty-five degrees Fahrenheit they can be kept asleep in captivity during the winter or for five or six months at a time. Their body temperature becomes approximately that of the air around them, they feel cold and have the appearance of being dead, but when not too cold, a slight trace of very slow respiration may be detected and the heart found to be beating very slowly and feebly. Their bodily condition is more than sleep and less than death but so reduced in all the vital processes that little of the stored-up food and fuel is consumed and in spring they awaken still well supplied with fat and ready to begin another season's activities. For the study of hibernation, which is not yet fully understood, these are among the best subjects of our native species of small mammals.

BROWN POCKET GOPHER

Thomomys fuscus fuscus Merriam

Sturdy little burrowers, usually abundant but rarely seen, the pocket gophers are a family by themselves, perfectly adapted to underground lives. They have powerful muscles and strong curved digging claws, heavy incisors, small eyes and ears, and compact bodies covered with smooth silky short hair. The tail is short and nearly naked but sensitive near the tip and is used to feel the way backward through the tunnels. The vibrissæ or mustaches are probably more useful inside of the closed burrows than the very small eyes. The big fur-lined cheek pockets, opening outside the mouth, from which they get their name, are used in carrying food back into the burrows for future use.

The powerful muscles and digging claws enable the gophers to extend their tunnels rapidly underground in search of food and comfortable living quarters and their abundance and wide range prove the success of their adaptation to underground life. Over most of the Yellowstone Park country this brown gopher is present in great abundance.

Little mounds of earth dotting the green turf over dry meadows, sagebrush valleys, flowery parks, grassy hillsides, and even the great green slopes between timberline and perpetual snow banks indicate the presence of pocket gophers. Only in the deep forests, on wet marshes, and on barren strips or patches where there is no vegetation are they absent. The mounds each contain from a quart to a bushel of earth, and are arranged in groups or lines, each marking an exit from the underground tunnel, where the gopher has opened a short side shaft to the surface and dumped the material excavated from his galleries below. The exit is securely closed after each mound is thrown out, and the gopher works on alone in the dark. Few people, even those who have seen these mounds every day of their lives, have ever seen a pocket gopher alive, as they rarely come more than their length out of the ground, and dodge back out of sight at the slightest sound or motion. They are especially sensitive to a step on the ground, even at considerable distance, and retreat at the slightest jar.

Their capacious fur-lined cheek pockets are always ready to be filled with such leaves, bulbs, roots, or underground dainties as may be found, or with clover leaves or other green vegetation around the doorway, when it is briefly opened to the upper world. And when the pockets are well filled, the food is carried to some storage chamber or held to be eaten at leisure in the safety of the underground world.

By peculiar adaptations pocket gophers are able to run backward or forward with equal ease and rapidity, and their motions in the burrows are quick and shuttle-like.

They are active all winter and work under the snow and be-

low the frost, always finding plenty of food, always stirring and mellowing the earth, making it more porous and fertile, and blindly cultivating the wild flowers, which in turn give them their food. However injurious to crops they may be in the farmers' fields outside, in Yellowstone Park and the mountains generally they are a harmless and useful, if little recognized, factor in the animal life of the region. They would repay with interest, as well as with knowledge of practical value, the time and patience that must be expended by the student who could enter upon a closer study than has thus far been made of their lives and habits.

RABBITS, HARES, AND PIKAS

WYOMING PIKA; ROCK CONY

Ochotona princeps ventorum Howell

The rock conies, pikas, or little chief hares, as they are variously called, are common in many places in Yellowstone Park, but, because of their timid natures and secretive habits, are little known and rarely seen by visitors. Usually they are found among the rocks in the Golden Gate, along the Sheepeater Cliffs, in the rock slide along Obsidian Creek just south of the Obsidian Cliffs, and again on the other side of the creek a little north of the main cliff, in the cliffs south and west of the Upper Geyser Basin, and along Spring Creek Canyon. In the rock slide along Aster Creek between Lewis River and Lewis Lake also their little heaps of hay may be seen along the roadside. They live near timberline on the east slope of Sheridan Mountain and in the rocks near Lynx Creek on Two Ocean Plateau. Skinner reports them in Gibbon Canyon. On the north slope of Quadrant Mountain they were squeaking among the slide rocks at timberline, while at Yanceys they were common in the coarse talus along the base of the cliff back of the old stage barn at only six thousand two hundred feet altitude. Their old hay and signs were found under the cliffs a mile west of Lake Soldier Station, and it is probable that they occupy every suitable cliff and rock slide in the park.

The main requisite for their habitat is a mass of broken rocks in which they can quickly dodge and hide from their enemies, finding a safe retreat in the twinkling of an eye, whether it be the eye of a hawk, fox, wild cat, or marten. From the weasel they are never safe. The conies are soft, gentle, rabbitlike bunches of dark gray-brown fur about as big as one's fist and about the shape of a meadow mouse, if it had larger ears and no tail at all. Their colors are wonderfully protective, blending so perfectly with



FIG. 43. Cony in the retaining wall of the road through Golden Gate, taken at six feet with a pocket camera, September 13, 1917.

the gray and brown rocks on which they live that they would never be seen but for the sharp little "bleat" or "yamp" that arrests one's attention. They have other call notes but this is the danger signal from the one who first discovers an enemy or any animate body large enough to be feared.

At the first alarm one of the conies takes up picket duty on the point of some rock and repeats his warning squeak until the danger comes near, when he dives out of sight among the rocks and the next one farther down the line takes up the danger sig-

nal, and so they pass it along as far as the enemy and the rock slide continue. However, one may sometimes approach the timid creature to close range, even to good camera distance, by talking softly and advancing very slowly. With time and patience the confidence of the conies may be won, and close at hand their interesting ways observed at leisure. Much remains to be learned of the homes and everyday habits of these delightful little haymakers of the mountains.



FIG. 44. Cony hay-stack under rocks at western edge of Upper Geyser Basin September 6, 1917.

With their furry soles they scamper noiselessly over the rocks in search of green food plants and in autumn gather and stack ample stores of hay for winter use. Under the shelter of an overhanging rock they will store a bushel or more of green plants, including many grasses, flowers, leaves, stems, twigs, and even berries from a great variety of plants, often almost every kind found in the vicinity. These dry and become well cured hay before they are buried under the deep cover of snow. In spring only the fragments remain, but the conies have passed

a safe and comfortable winter among their hay stacks. Often along the bases of cliffs the snow is ten to twenty feet deep and shuts them in securely for six months or more, but it also shuts out their enemies and gives them much-needed protection. With plenty of open space among the rocks and an ample food supply stored for the winter they have the advantage over many outside friends and foes that have to hunt for food and shelter while exposed to numerous dangers.

Really nothing is known of how their winter is passed, whether socially in generous sharing of food or whether in individual defense of supplies, as with so many other animals. The spring-time shows most of the food eaten and most of the "hay stacks" reduced to woody refuse in the midst of well worn feeding yards and a mass of little hard dry shotlike pellets from the winter droppings.

Of the breeding habits we know only that usually four (three to five) embryos are found in females collected in spring and that the young when first seen in the rock slides in June or July are apparently a month old. Some half-grown young taken in September seem to indicate that a second litter may be raised.

Too small to be counted as game, the conies are safe from man except when needed for study specimens or occasionally when a hunter finds himself without other food. Their flesh is rabbit-like, and when broiled on the coals, even without salt, makes a very good meal. Their greatest value, however, is in making the rough places in the mountains teem with life and human interest and in establishing a friendly bond between man and his four-footed kin.

ROCKY MOUNTAIN COTTONTAIL

Sylvilagus nuttalli grangeri (Allen)

Cottontail rabbits are usually abundant in the sagebrush valley about Gardiner and along the Gardiner River up to Fort Yellowstone and the Buffalo Corral, but they do not extend over the higher levels of the park nor beyond the limits of

Transition Zone. They are usually shy and timid, as they are constantly pursued and frequently captured by coyotes, and it is necessary for them to seek the cover of dense sagebrush or broken rocks, where they can dodge and escape their enemies. In the open they are no match for the coyote in speed, but in the brush, being expert dodgers, they can generally get to safe cover if not surprised at too close quarters. Bobcats, foxes, hawks, and owls are also counted among their enemies and to them life is a series of narrow escapes, with a tragic end. Close to the edge of some talus slope of a cliff or along the broken walls of a canyon they often survive in considerable numbers by keeping within a few jumps of sheltering rocks or where they can quickly hide in a dense thicket and nibble the little green plants close to cover. Rarely do they venture into the big open places or enter the forest that might hide their enemies. Eyes, ears, and legs are their only means of protection, and they are not favored with long legs as are the wide-ranging jack rabbits. Still their skill at dodging, great caution, and prolific breeding habits have maintained the species over a wide range of rocky and sagebrush country from California to North Dakota.

SNOWSHOE RABBIT

Lepus bairdii bairdii Hayden

Snowshoe rabbits are fairly common throughout the Canadian Zone timbered area of the park, but in summer are not often seen, because their brown coats blend so well with the fallen pine needles and forest shadows that they are inconspicuous, unless in motion so as to show their white feet. In winter they are equally inconspicuous in their pure white coats as they scamper over the soft unbroken snowdrifts on big furry feet, or follow their well beaten trails through the thickets and dense forest undergrowth.

Outside of the park their numbers vary greatly from year to year, usually increasing through a series of years until they become abundant, then decreasing until very scarce. During the

summer of 1915 they were fairly common throughout the forest and again in 1926 many were seen along the trails, but no record has been kept of their relative abundance for succeeding years to show the periods of rise and fall. There seems to be no record of excessive abundance of these rabbits in the park, possibly due to greater numbers of their natural enemies among the fur bearing carnivores. Moreover, there seems to be no record of any rabbit epidemic such as commonly carries off great



FIG. 45. Snowshoe rabbit in winter coat on bare ground. Near Cora, Wyoming, 1906.

numbers outside of the park after periods of excessive abundance. If keeping a permanent check on overabundance of a species prevents disease the principle might be applicable to other parts of the country and to other species. At least here is a rare opportunity to study one of the important factors in game management.

One of the principal enemies of the snowshoe rabbits is the Canada lynx, which hunts them summer and winter, and with his big furry feet is almost as well equipped for snow travel as they are. Bobcats rarely come into their life zone, but foxes,

coyotes, martens, minks, and possibly weasels can be counted among their enemies, while the large owls and hawks probably take toll of their numbers.

Their food in summer consists of a great variety of green vegetation and in winter of the buds, bark, and twigs of numerous bushes, which are cut off above the surface of the snow as neatly as if done with a sharp knife. As the snow deepens the rabbits rise higher and higher above the ground, always to a fresh supply of food. With these food habits, their snowshoes, and dense furry coats, they are peculiarly fitted for the high-mountain and north country that they inhabit.

As the snow disappears in spring their white hairs break off and are replaced by the buffy gray underfur, which lasts until the spring molt brings the gray-brown summer coat. The white coats have been reported by Skinner up to April 3 and April 19, and the first brown coats on May 11. Many additional data are needed, however, before satisfactory dates of molting can be given.

In July, 1926, a few of these timid forest dwellers were living among the tourist camps at Old Faithful, sleeping during the middle of the day under the cabin floors and coming out about sundown to nibble grass and clover around the doorsteps. Again they were seen about sunrise in the morning close to our doors before seeking cover for the day. They had lost all fear and seemed to realize the protection afforded by man. They would not come to my hand for food but made no objection to my presence a few feet from them and were one of the attractive forms of unfrightened wild life of the place.

PRAIRIE HARE; WHITE-TAILED JACK RABBIT

Lepus townsendii campanius Hollister

Jack rabbits are common in the open country at the north end of the park, about Gardiner, Mammoth Hot Springs, in the Blacktail Creek valley, and along the open valley of Lamar River in Transition Zone. They are especially common about Gardi-

ner and Mammoth Hot Springs, where in summer a few may be seen in buffy gray coats around the edges of the alfalfa field at Gardiner, or on the lawns at Mammoth. In winter, in their pure white coats, they gather in still greater numbers and are often seen feeding on hay scattered along the road for deer and other animals.

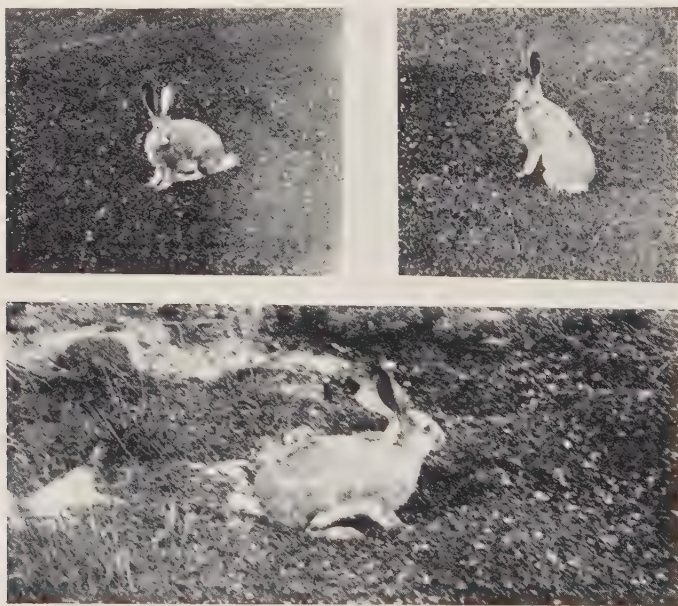


FIG. 46. Jack rabbits in gray coats, taken at Mammoth Hot Springs, August, 1926.

Their large, well furred feet carry them over the surface of the snow out of reach of coyotes and most other enemies, while on the bare ground their great speed usually protects them. In both summer and winter they are surprisingly tame for rabbits, and may be photographed at close range as they hop about in their gray summer coats nibbling clover on the lawns or sit in their white winter fur on the snowbanks.

As the snow disappears in spring the white tips of the hairs break off and their color changes to buffy gray. One seen, on

April 1, 1916, was in a mottled gray and white coat and another seen, on April 3, was in the buffy gray of the worn fur.

The largest and finest of our hares, these big prairie dwellers have little fear of coyotes or foxes if they have a fair field for speed, but a good grayhound will pick one up on the prairie and automobiles will crowd them out of the roads at a speed of about thirty-five miles an hour. Along good roads on the prairies many are shot from automobiles "just for fun" and in places they are almost wiped out of existence. In rough country, however, they hold their own and occasionally increase to unusual numbers; then scatter out and restock the old ranges. On the whole they seem not to be decreasing in numbers over most of their original range, and in places they are spreading into new territory.

As game they are the most important of the jack rabbits, generally healthy, plump, and in good condition for food, and if well cooked provide a very palatable meat. Their skins too have considerable value as fur, and in some places these rabbits are counted as valuable game animals. In rare instances they gather locally in such numbers as to become a pest and have to be destroyed to protect crops or winter stacks of alfalfa hay, of which they are fond.

Generally they are so wild and swift that little is learned of their real habits and natures, but in Yellowstone Park they have lost their fear of man and can be studied at close range under most favorable conditions. There is still much to be learned of their every day habits and their true relations to man and other animals.

FLESH EATERS

MOUNTAIN LION

Felis concolor hippolestes Merriam

In past years mountain lions have been very troublesome and have destroyed much of the large game, but at the present time they are comparatively scarce, as they have been persistently hunted in and around the park. They are shy secretive animals



Photo by Olaus J. Murie

FIG. 47. Mountain lion at bay in tree.

and their presence is rarely detected, except by their tracks, which are occasionally seen in summer along the trails and more often in winter on the snow. On December 6 and 7, 1915, Donald Stevenson reported fresh lion tracks near Pelican Creek, and on December 10 two trails on the divide between Lamar River and Deep Creek; on January 7, 1916, he reported tracks near Bunsen Peak, and on February 15, 16, and 17 he caught an old lion and three well grown yearling cubs on Geode Creek. Later, on March 16, he found the track of another lion on Geode Creek, and on April 9 tracks of four others near Cold Spring at the junction of Lamar and Yellowstone rivers. The next day he saw three tracks near the Needles in the Yellowstone Canyon. These lions were in most cases feeding on elk that they had killed, and apparently they had come down from the higher mountains with the fall migration of the elk herds. In summer they seem to prefer the high country where elk and also mountain sheep are abundant, and there their depredations on the game are undoubtedly more serious than is generally realized. One large game animal, such as an elk, a moose, a deer, or a sheep, is required by these big cats every few days, and where game is abundant one animal freshly killed and partly eaten each day may not be too high an estimate of their depredations.

At present mountain lions are few and far between. The last one killed was treed and shot by chief ranger Woodring in November, 1924. In 1926 one was seen by a fisherman near Camp Roosevelt but on our round of the trails with the Sierra Club party not a track was seen. In March, 1928, tracks of a mountain lion were reported by chief ranger Woodring on a snowshoe trip around the Geyser Basin (Nature Notes) but their numbers are down to a fairly harmless minimum. To many it is a pleasure to know that they are still present, though rarely seen. Cowardly and generally harmless in the presence of man, they are so secretive in their habits that they add little interest to the animal life of the park to compensate for their destructive habits.

CANADA LYNX

Lynx canadensis canadensis Kerr

During the summer of 1915 a few tracks of the Canada lynx were seen along the Upper Yellowstone and near the north-western corner of the park, and the animals were said to be common and generally distributed throughout the timbered region. They are usually common where the snowshoe rabbit is most abundant, and become scarce in any area as the rabbits disappear. Rabbits are their main source of food, but they are stealthy prowlers, and any small game that comes in their way is acceptable. They are doubtless in part responsible for the scarcity of grouse in the park and are strongly suspected of killing many young deer and sheep and possibly elk, but are such silent poachers that charges against them are not easily proved. Their menace to game has become more apparent since Charles Sheldon found them in winter in Alaska killing full-grown mountain sheep.

Their great furry feet give them the advantage over most game as well as predatory animals in winter, as they travel easily far and wide over the deepest snows. In summer, these same furry feet render them as silent as the owl, and in meadows, woods, and thickets they are as invisible as if their gray coats were a part of the shadows. Although in winter strikingly handsome animals, with long soft gray fur, long black tassels on the tips of the ears, and a solid black tip to the stubby tail, in summer they are much less beautiful in their coats of short brown fur. They are so rarely seen as to add but little to the interest of the animal life of the park. While complete extermination is not desirable, any great abundance of these cats should be discouraged.

ROCKY MOUNTAIN BOBCAT

Lynx uinta Merriam

Bobcats inhabit the lower levels of at least the northern section of the park, and though no specimens are available from the region for actual comparison, it is probable that they are

the same as those of southern Wyoming, to which the name *monti* has been applied. From the Canada lynx they are distinguished by smaller legs and feet, less conspicuously tufted ears, more mottled and yellowish gray color, and by the black upper and



Photo by H. H. Sheldon

FIG. 48. Bobcat in mountains of Colorado.

white lower part of the tip of the stubby tail. They are especially animals of the low open country and are generally found along cliffs and canyons where caves and caverns afford them shelter, dens, and good hunting grounds.

Their chief prey consists of small game, and while as partial



FIG. 49. Three old wolves killed by Stevenson and Black near Hell-roaring Creek, and a breeding den in cavern under rock from which six young wolves were taken in April, 1916.

to the cottontail rabbit as the Canada lynx is to the snowshoe rabbit, they also catch large numbers of wood rats, pocket gophers, ground squirrels, and such small game. Unfortunately, however, they often kill larger game, and the young of deer, antelope, mountain sheep, and probably elk are never safe in their vicinity. Their limited range in the park, therefore, is not to be regretted.

GRAY WOLF; BUFFALO WOLF

Canis lycaon nubilus Say

The large gray wolves at times have become abundant in the park and wrought great havoc among the game animals, but at present they are being hunted so persistently over much of the outside range as well as in the park that they have become extremely scarce. During the summers of 1914 and 1915, they were especially destructive in the park and were following the elk herds to the high pastures of Mirror Plateau, returning with them in winter to the valleys along the Lamar and Yellowstone rivers. In the summer of 1915, Mr. Frazier, at the Buffalo Ranch, told me that wolves had been very troublesome during the preceding winter and had killed many elk. He said that from the ranch he would often hear an elk bawling in the night and the next morning see ravens circling over a half-eaten carcass. During June of that year, Mr. Frazier killed two half-grown wolf pups and caught two more, which were kept chained up at the ranch. During July and August, 1915, I found where a family of wolves had killed and eaten a young elk in Slough Creek valley and found wolf tracks along Slough Creek and Lamar valleys up to the mouth of Mist Creek, also along Pelican Creek, and later a few tracks on Fox Creek at the southern edge of the park. Tracks were especially numerous along Pelican and Raven creeks, where at least ten or a dozen wolves hunted in one pack.

In November, 1915, Donald Stevenson counted nine separate tracks, where a band of wolves had crossed a sandbar on Pelican

Creek, but at that time they were leaving that section of the park and following the elk herds to lower levels. In January, 1916, they were found in the Lamar and Yellowstone valleys, where Stevenson and Black secured four of the old wolves and later a family of seven pups. With persistent hunting and trapping during the spring this band of wolves was broken up, and apparently most of those not procured were driven out of the park. Evidently a few remain, however, and, as they breed rapidly, constant care must be exercised to prevent their becoming re-established in numbers to do serious damage to the game. In 1926, I saw a few tracks on Two Ocean Pass and the members of the Sierra Club party saw one wolf on the side of Trident Plateau.

BREEDING HABITS.—The fact is now well established that wolves pair permanently or until one of the pair meets with some accident. The male guards the den, hunts for the mother wolf and young, and later leads the family and pack.

The large families of young are generally born in the latter part of March or early in April, the number ranging from seven to nine, but litters of eleven and thirteen have been recorded. When first born the young are almost black, but in a few weeks they begin to fade to a dull yellowish gray. The dens are usually situated in caves or hollows among rocks or sometimes in large burrows on steep hillsides. One found by Stevenson and Black, on the rough slope near Hellroaring Creek on March 26, was watched for some days in an effort to shoot the old wolves, which finally became suspicious and carried the pups away to another location farther up the side of the mountain.

The den was described as composed of four or five large burrows dug into the open hillside, and had evidently been used for several years, as a score or more of old elk skulls were lying about, and one fresh elk head that had recently been brought in was found. On April 14 this family of wolves was located about a mile from the first den in a natural cave among some loose rocks. Back about eight feet from the entrance of the cave seven

wolf pups, estimated to be three weeks old, were secured. A freshly killed young elk was found about half a mile from the den and there were pieces of elk meat in the den with the pups. The old wolves were very shy and kept well out of sight while the den was being watched, but were frequently heard howling and answering each other from different points, and the old male was several times seen guarding the den from a point high above. The male is considerably larger than the female, weighing well over a hundred pounds.

DESTRUCTION OF GAME.—Wolves are powerful animals, and their habit of hunting in pairs, families, or packs enables them to pull down and kill any game animals, even to the size of full-grown buffalo or elk. Where game is abundant, as in the park region, they kill mainly those animals easiest to obtain, which are generally the young and cows. They prefer freshly killed meat and usually kill one or more animals every night for food. On Pelican Creek, in 1915, along the trails which they were constantly using, their droppings were made up entirely of elk hair, and a scarcity of elk calves was very noticeable among the herds in that section. Ravens were especially numerous there at that time, as in sections where game is being regularly killed. One game animal killed every twenty-four hours is probably not too much to allow for each adult wolf where game is abundant. It is therefore evident that wolves and game can not be successfully maintained on the same range.

COYOTE

Canis latrans nebracensis Merriam

Coyotes are common throughout all the open country of Yellowstone Park and in all except the densely timbered and high mountain areas. They are often seen in the open parks and meadows just beyond easy rifle range, and their tracks are everywhere in the roads and trails. In the early morning or late evening and sometimes at night their shrill quavering howl and hilarious yapping may be heard not far from the camps and ho-

tels, and even sometimes in broad daylight. They are among the few animals that are as shy and wary in the park as outside, for the obvious reason that they at times are shot and trapped by professional hunters and made to realize that their presence is undesirable.

Specimens from about Gardiner, Yanceys, and Lamar River valley are rather small and pale buffy yellow, evidently belong-



Photo by M. P. Skinner

FIG. 50. Coyote hunting mice in Yellowstone Park.

ing to the plains subspecies, *nebracensis*. In the more elevated timber region farther south the individuals seen appear to be larger and darker and more brownish in color and not improbably are nearer to either typical *latrans* or *lestes*.

Near the mouth of Beaverdam Creek one of these large dark coyotes followed me through the sagebrush one morning, while I was hunting the camp horses, and kept sneaking closer and closer until I had a good view of him at only fifty yards. He was so large that I looked closely to make sure that he was not a

wolf and until satisfied that he was really one of the large mountain coyotes. Large coyote tracks were noted along the Yellowstone Valley above the lake and over Big Game Ridge and on the head of Falcon and Mink creeks on the upper Snake River. In habits this larger form differs from the other chiefly in showing more partiality to the timbered and brushy areas of the mountains.



Photo by M. P. Skinner

FIG. 51. Coyote hunting mice in Yellowstone Park.

BREEDING HABITS.—Coyotes are usually found in pairs or family parties, and the male is devoted to his family. He stays near or at the den, brings food for the young, and leads the family hunt. Five to seven young are born in some little cave or cavity among the rocks or in a burrow that has been dug by the parents or enlarged from a badger hole.

The young are generally born during the month of April and at first are almost coal black. Before their eyes are opened, however, the black begins to fade and soon becomes a soiled yellow

color that blends very well with the earth of the den in which they live. Soon after their eyes are opened meat is brought to them at the den and they are kept well supplied with game until old enough to follow the parents on hunting expeditions. By August they are nearly full-grown coyotes and generally hunt in family packs until autumn, when they scatter and to some extent do their hunting singly or in pairs.

At times coyotes feed largely upon dead animals, those that have been killed by wolves or mountain lions or have died of old age or severe winter conditions. While in part they serve as scavengers, nevertheless, they are expert hunters, and if better game is not available they can usually catch enough mice, pocket gophers, ground squirrels, and rabbits on which to live. If this were the extent of their hunting they would be comparatively harmless and, in great measure, beneficial, but they miss no opportunity to capture domestic stock and the smaller game animals, especially the young of deer, mountain sheep, antelope and elk. In summer they are constantly prowling over the breeding grounds of these animals and get a great many of the young, as evidenced by the hair in their droppings along the trails. They are occasionally seen chasing deer and antelope and two have been seen to pull down and kill full-grown antelope and full-grown deer. I have found a number of antelope that had evidently been killed by them. It is probable that they also get some grouse and other small game in the park, but their serious depredations are on the young of the large game animals.

ECONOMIC STATUS.—The great abundance and general distribution of coyotes render their complete destruction practically impossible. Through concerted effort, however, their numbers can be greatly reduced by trapping and hunting and their depredations thus kept down to a minimum. A few coyotes in the open areas of the park would find such an abundance of small game that they would do little harm to the larger species and would serve as a useful check on the overabundance of rodents.

In the surrounding country, however, it is necessary to wage constant warfare on them to protect sheep and other domestic animals and unless they are also destroyed in the park they will naturally resort to it as a protected area of abundant food supply. During the year beginning October 1, 1914, about one hundred coyotes were killed in the park, and the following year about one hundred and seventy-three were killed by the park guards and hunters employed for the purpose. As a result the decrease in abundance of coyotes in the northern part of the park was very noticeable in the summer of 1916; but in 1917 their tracks were again numerous along the trails. In 1922, the park rangers and trappers killed two hundred and twenty-three coyotes and the next year two hundred and twenty-six were reported killed. In 1927, *Nature Notes* reported that over two hundred coyotes were killed annually but that the species was still numerous in the park.

MOUNTAIN RED FOX

Vulpes fulvus macrourus Baird

A few red foxes are occasionally seen in the park and their tracks or pungent odor are often noticed along the trails and roads. Generally the animals are of a light yellow color with black breasts, legs, noses, and ear-tips, and a white tip to the tail, but some are of the darker cross-fox type with the dark band over the shoulders and more extensive black markings. One silver-gray was reported caught south of the park a few years ago, but I have been unable to get any record of a black fox for the park region. All these forms are merely stages in the color variation of one polychromatic species from the lightest red to the cross, silver, and black phases. The large white tip of the tail is always normally present, however, in the red fox and distinguishes it from the kit fox of the plains, the gray fox from farther south, and from the coyote. The long winter fur of the fox makes it look almost as large as the coyote, but when skinned it proves to be very slender, light, and delicate, and scarcely heavier than the ordinary house cat.

The prey of foxes consists mainly of mice, pocket gophers, ground squirrels, and such birds as they are able to catch. Feathered game is practically all that they can be accused of disturbing, although it is not improbable that on rare occasions they may kill very young fawns or the young of antelope and mountain sheep. They are beautiful, swift, and graceful animals, but so scarce that their presence is not likely to add much of interest to the average tourist and sightseer. Their fur is so much in demand and they are so thoroughly trapped in the regions about the park that they probably will never become abundant.

CANADA OTTER

Lutra canadensis canadensis (Schreber)

Otters are common along some of the streams in the park and have been reported from Yellowstone River and Hellroaring Creek, around the shores of Yellowstone Lake, and along the river above the lake. Their tracks were seen along Lamar River and Snake and Lewis rivers, and Skinner reported them along Gibbon River and in Willow Park on Obsidian Creek. They are said to be especially common along Lewis River and around the shores of Yellowstone Lake, where they are often seen in considerable numbers.

In habits they are almost as aquatic as the beaver, but even in the water they are readily recognized by their long lithe forms and their long tapering fur-clad tails.

They swim rapidly and dive and pursue their finny prey under water with great speed and skill. With their short legs they are at great disadvantage on dry land, and their motions are slow and awkward, but their webbed feet and muscular tails serve as powerful propellers in the water.

In summer they find abundance of food among the fish, frogs, and crustaceans of the lakes and streams, and in winter they frequent the open water to be found along the rapid streams or where warm springs come into the lakes and rivers. While a large part of the otter's food consists of fish, it is probable that

many of those caught are the old or imperfect individuals, which can well be spared.

The value of the rich brown otter fur puts such a high price on their hides that outside of protected areas they are rare, and the park is one of the few places in the country where they may be studied under natural conditions. Their winter habits are especially interesting and it would well repay a snowshoe trip through the park to watch them sliding and coasting on the soft



FIG. 52. Otters in National Zoölogical Park sporting on snow bank in winter, 1909.

snows. In spring especially they often leave the water and travel long distances on land, from one stream to another, while the snow is soft and they can slide rapidly over its surface.

Little is known of their breeding habits, except that the two to four young are occasionally found in hollow chambers or among rocks along the stream banks.

MINK

Mustela vison energumenos (Bangs)

A few minks are found along some of the streams in the park, but they are not very common or generally distributed. Tracks were seen on Slough Creek and on the northern end of Yellowstone Lake, and Skinner reported seeing one in a beaver pond at the Yellowstone bridge, one near Riverside, and one below the mouth of Alum Creek on the bank of Yellowstone River. Saw-

yer reported one in a beaver pond at Blacktail Creek and one at Lava Creek. Others were reported on Polecat Creek near the south line of the park. Along Mink Creek in the southern part of the park I could not find even a track, but it is probable that individuals occasionally follow most of the streams in the park.

They are rarely found far from water, and while less aquatic in habits than the otter, they are expert swimmers and divers and often pursue their prey below the surface. They feed upon fish, frogs, and crustaceans and to some extent also hunt for mice, gophers, and muskrats or any small game that may be found upon the land or in the water. With sufficient inducement they will even climb trees. In the surrounding ranch country they occasionally kill poultry, and it is perhaps well for the breeding waterfowl of the park that they are not overabundant.

During the last week of January, 1929, park ranger Roy G. Dale¹¹ reported three minks in a pond on Polecat Creek near the south line of the park. The weather was cold with forty inches of snow on the ground but the pond, kept open all winter by warm springs above, was a favorite resort of waterfowl. Six swans, some wild geese and about a hundred ducks were living in it and the presence of three minks, one otter, and a bald eagle afforded a situation for important study.

At Lava Creek Bridge in July, 1925, park naturalist Edmund J. Sawyer saw a mink chase and catch a ground squirrel, which squealed when it was caught and injured. A large marmot near by stood up on its hind feet when it heard the squirrel's cry of distress, then ran straight at the mink which dropped the dying squirrel, ran for the creek and jumped into the water. The marmot followed to the bank, then climbed up on the railing of the bridge and, seeing no more worlds to conquer, sat up and washed its face. On another occasion Sawyer¹² saw a mink deliberately attack a medium-sized marmot.

¹¹ Nature Notes, vol. 6, no. 2, p. 5, February 1, 1929.

¹² Nature Notes, vol. 2, no. 3, p. 2, July 20, 1925.

Although small, their beautiful soft brown pelts have a high fur value, and constant trapping in the areas around the park probably keeps down their numbers to the present low stage. They are great wanderers, and some of those in the park at times undoubtedly stray outside and are caught farther down the streams.

ARIZONA WEASEL

Mustela arizonensis arizonensis (Mearns)

Weasels in the brown summer coat are occasionally seen hunting for ground squirrels and mice in the meadows and over the open ground of the park; and in winter their tracks are common over the snowfields, while occasionally white-coated animals with black-tipped tails come into camps and cabins and become very tame. One taken in Jackson Hole south of the park in September was of the usual yellow-brown color with a pale yellow belly; another, a male of medium size, seen at the Buffalo Ranch in March was pure white, except the black tip of its tail; while another seen in the Blacktail cabin in March, 1916, evidently a little female, was also pure white except the black tip to the tail.

She had been occupying the cabin along with one of the trappers, Donald Stevenson, for several weeks and had become quite unafraid, running over the walls, tables, and beds in a very familiar way; and after the mice were all caught from the cabin and barn, varied her regular diet by gnawing the dry meat from the skulls of wolves, coyotes, and mountain lions, which were kept in a row on the cabin shelf. She had to go to the old stable or under the snow in a meadow to catch a fresh supply of mice, and divided her time between home life in the comfortable cabin and outdoor hunting trips. Her little paired tracks on the surface of the snow showed the direction and radius of these trips so far as they extended above the surface, but most of her hunting was done under the snow or under such cover as served also to shelter the mice. Her snowy coat and beady black eyes, graceful form, and lightninglike motions made her a most inter-



FIG. 53. A marten photographed at ten and fifteen feet up a tree, near Mountain Creek, August, 1915; two photographs combined.

esting companion in the lonesome cabin. While quite fearless, she was so nearly immaculate that no one objected to her running among the dishes on the table or over the bed covers at night, and the freedom from mice in the cabin was a great protection to food and other supplies.

In summer, weasels feed on the small rodents and are constantly running from one burrow to another, killing great numbers and serving as an important check on the overabundance of animals that might otherwise become pests. While they may catch an occasional bird, it is doubtful if such mischief bears any comparison to the good they do in keeping down rodent pests.

DWARF WEASEL

Mustela cicognanii leptus (Merriam)

A very small weasel is reported as occasionally seen in the park, and a tiny track that I saw near Lewis Lake may well have been made by the dwarf weasel, which is found throughout the mountain region around the park. It is not so large as some of the mice that it hunts, but in general appearance and in habits it is a miniature of the other weasels, turning white in winter and brown in summer.

ROCKY MOUNTAIN MARTEN

Martes caurina origines (Rhoads)

Martens are fairly common in the park, which is one of the few areas within the United States where they may be seen actually running at large. Skinner has reported them from many places in the park. On Mountain Creek, I had the good fortune to frighten one up a tree close to the trail as I passed, and was able to watch it as long as I wished within snapshot distance of the camera. It was not much frightened and sat on a branch ten feet above my head, watching me with an interest apparently equal to mine. Its soft yellow-brown fur and orange throat, bushy tail, and keen alert expression made a pretty picture as it sat on the branch looking down at me. Martens are expert climbers and obtain a part of their game in the treetops.

Unlike the mink, they hunt through the woods rather than along the streams and run from tree to tree in search of pine squirrels, chipmunks, and the small feathered game that constitute their usual bill of fare. It is not improbable that they may be in part responsible for the scarcity of grouse through the park forests, but even so their own value as fur-bearers and the unusual interest they afford the student of wild animals compensate in large part for the small amount of mischief that they may do. The supply of martens in the region around the park is undoubtedly in part kept up by the overflow of those raised within its borders.

FISHER

Martes pennanti pennanti (Erxleben)

Fishers are rare animals in any part of the United States, but a few are caught by trappers throughout the higher mountain levels of the Rocky Mountain region, and there is one record for Yellowstone Park. This is based on a skin taken from poachers by General Anderson, "in the early nineties," as recorded by Seton.¹³

The fisher is several times larger than the marten, and its long soft fur is a mixture of dark gray and brownish black. It is a sturdy animal, with short ears and a bushy tail, but with relatively longer legs than the marten. In habits it is also a forest hunter and an expert tree climber and is said to pursue squirrels in long leaps from one treetop to another. The name fisher apparently has no significance, as the animals are rarely found in the vicinity of water. Their skins are valuable for fur, but few are now taken within the United States, as their range is mainly in the north or in elevated mountain areas.

WOLVERINE

Gulo luscus (Linnaeus)

Wolverines are said to be well distributed over Yellowstone Park and a few are caught each year around the borders. They

¹³ Ernest Thompson Seton, *Wild Animals at Home*, p. 225, 1913.

are never abundant anywhere, but as they are great wanderers, a few will cover a large extent of territory. They are heavily built animals, considerably larger than the fisher but with short legs, short ears, and short bushy tails, and are very powerful and savage fighters. Their fur is rather long and coarse but attractively marked with broad yellowish bands along the sides of the back in striking contrast to the dark rich brown or black of the body color. The skins are popular for robes, overcoats, and various forms of wearing apparel, and command high prices in the fur market. To the trappers, wolverines are always a valuable catch, but alive they are a source of great annoyance in breaking up traps for smaller animals and eating or destroying many of the other fur-bearers found in traps. They are said also to break into caches of provisions and supplies, destroying valuable stores, and long ago earned the names of "glutton" and "Indian devil."

Their food consists largely of such dead or crippled animals as they are able to find, but their short legs fortunately prevent their catching adult or able-bodied large game.

Like the bears, they are largely scavengers, and in the park can usually find enough carcasses left by wolves or the ravages of severe winters or old age to supply their needs. A large number of such animals would not be desirable in a national park, but a few are practically harmless, and as they have become extinct over most of their original range in the northern United States the larger parks are the only refuges where they may be expected to remain permanently within our boundaries. In the far north a few are still taken as a part of the annual fur crop. Their fur is especially prized by the Eskimo for hoods as frost does not adhere to it.

NORTHERN SKUNK

Mephitis hudsonica Richardson

Skunks are fairly common in the lower areas along the northern part of the park, but apparently do not reach over much of the higher plateau area. They are found along the Yellowstone,

Gardiner, and Lamar valleys, and are also reported from the Gibbon River valley and from the region about the north end of Yellowstone Lake. As they are common in the northern part of Jackson Hole, it is probable that they also occur along Snake River near the southern border of the park. It would not be strange to meet a skunk along any of the stage roads in the park, but their main range is included in Transition Zone.

The northern skunk is one of the larger species, with two diverging white bands from the neck along the sides of the back, conspicuous on the glossy black fur. Their best recognition mark, however, is their powerful odor, which may often be detected along the roads where they have been rudely disturbed. This weapon of defense is not used except in case of sudden attack or extreme danger, and the animals may be watched and studied safely at a distance of fifteen or twenty feet if not unduly excited. The large bushy tail is always raised as a warning when danger threatens, but the danger is generally greater to the attacking party than to this otherwise defenseless and harmless animal. The powerfully odoriferous fluid contained in the two glandular anal sacs can be thrown through the two small ducts in fine streams to a distance of twelve or fifteen feet. The motor power for these streams lies in a broad band of muscular tissue surrounding the two glands, which, by simple contraction, forces the fluid through the nipple-like openings.

In cases where skunks take up their quarters under buildings or floors of camps it may be necessary to remove them, and this can be done without any unpleasant results by trapping them in a box trap or under an inverted box with one end raised on a figure-four trigger. In a dark box they can be carried away without becoming excited and released where they are not likely to return, or else given to some fur farmer who will keep them safely enclosed until the fur is prime. Only occasionally, however, are skunks undesirable neighbors, and their presence adds much of interest to any outdoor region.

While largely nocturnal in habits, they are often seen during

the morning or evening hours pursuing their customary routine of catching grasshoppers, beetles, and other large insects, or nosing about in the meadows and grass for ground squirrels and mice, especially for mouse nests that contain young. They will also feed on carcasses and are fond of the maggots and maggot chrysalids that they find in such places. On rare occasions they may disturb poultry, and they doubtless rob the nests of some ground-nesting birds, but generally their food habits are beneficial, and their presence may be considered desirable rather than otherwise. In the park, where they are not being constantly excited by dogs, they are especially unobjectionable and a valuable asset.

With the abundance of summer food they become excessively fat, and with the first snows of winter enter their deep warm burrows, where they curl up for an all-winter sleep. As soon as the snow disappears in spring they emerge from their dens, generally in good condition, and begin to look for a new supply of food, while the males travel from place to place in search of mates. Like all members of the family, they are polygamous and the female is left alone to care for her young and, strange as it may seem, to protect them from the cannibalistic males. The young are cared for in the burrows until old enough to be taken out, when they may be found in family parties of six or seven following their mother like a brood of striped chickens, while she leads the hunt for grasshoppers and mice. Even at the early age when they first leave the burrows, the young ones are well provided with their weapon of defense, although the little fellows usually allow gentle handling without resorting to its use. At this age they quickly become tame and, if the scent glands are removed, make extremely interesting and perfectly safe pets.

BADGER

Taxidea taxus taxus (Schreber)

Badgers are common in the open country along the northern part of the park from Gardiner up the Yellowstone Valley to

the canyon, in the Lamar and Slough Creek valleys, and a few in the West Gallatin Valley. Over the higher levels of the park they are scarce, but a few occasionally wander over the open areas, where ground squirrels, pocket gophers, and mice are most abundant. In fact their range and abundance corresponds closely with that of the common ground squirrel, or picket-pin, which furnishes a large part of their food.

With his long front claws and powerful muscles the badger is a sort of miniature steam shovel, and most of his energies are spent in scooping out the burrows of smaller animals which best suit his palate. The fat little ground squirrels not only offer tempting morsels, but their simple burrows are easily excavated and at the bottom the badger usually finds a good warm breakfast. Even after the squirrels have hibernated in fall he still keeps digging out their burrows and feasting upon the dormant occupants until the ground freezes so hard that digging is no longer an easy matter. Then he seeks his own deep warm burrow in which to sleep through the rest of the winter.

While the ground squirrels generally enter their burrows in August, the badgers often remain out until late September or early October, or until the snow becomes very much in the way of their short legs. The warm March weather usually brings them out again, even before the snow has disappeared, and some time before the appearance of the ground squirrels. They commonly emerge with a good supply of fat left, and any animal carcass will furnish them food until the ground is thawed and they can once more begin to dig for squirrels, mice, and gophers. The males often travel for long distances over the crusted snow in spring in search of mates, but the females are left to take all the responsibilities of the home and family.

As a check on the overabundance of rodent pests badgers are extremely useful animals, but with the ranchmen they are unpopular on account of the numerous burrows that they leave scattered through the grass and sagebrush as a lurking danger to horses and riders. Even drivers of automobiles have many

bad words for the badger as they bump into his burrows in the wheel tracks of otherwise perfectly good roads. In spite of the fact that all of his burrows are dug in pursuit of pocket gophers, ground squirrels, prairie dogs, and other rodent pests, the badger gets only blame and is unjustly murdered at every opportunity by the residents of the country. In the park, aside from being useful, the badgers furnish an interesting part of the animal life, and in any agricultural valley they are also valuable assets and should be protected by law and public sentiment.

RACCOON

Procyon lotor lotor (Linnaeus)

Raccoons have been reported in the park, but I have been unable to find evidence of their presence, even along the Yellowstone and Gardiner rivers where they would be most likely to occur. They are found farther down Yellowstone River and may at times extend up into the edge of the park. Their long, plantigrade tracks are so characteristic and unmistakable that their presence in any part of the country can quickly be detected by following the sand bars and margins of the streams.

BLACK AND CINNAMON BEARS

Euarctos americanus cinnamomum (Audubon and Bachman)

Black and cinnamon bears are especially common in the park, where they gather about the hotels and camps to feed on garbage. Often ten or a dozen of various shades from light brown to glossy black may be seen feeding at a garbage pile during the early evening or morning hours, and sometimes twenty or thirty gather at a time at one favorite heap. They are also generally distributed throughout the forests of the park and apparently many of them do not come to the hotels, but remain as wild bears subsisting on such food as the forest affords. They are much more numerous than the grizzlies. The official reports by park authorities of two hundred black and sixty grizzlies in 1924, two hundred and twenty-five black and eighty grizzlies in 1926 (Nature Notes), and four hundred and forty black and

one hundred and fifty grizzlies in 1929 give the best estimates of numbers that are available. Those at the feeding places are easily counted but in the wilds the few seen and the tracks and signs of others can be only estimated by those most familiar with the trails. Many of the bears wander at times beyond the limits of the park and some are occasionally killed outside, while a few become troublesome or dangerous through association with



FIG. 54. Englemann spruce and lodgepole pine stripped of the lower bark by bears for the sweet cambium beneath, July, 1915.

people in the park and have to be killed. Nevertheless the supply holds out well and the numbers seem to be slightly on the increase and entirely under control.

Few animals are more omnivorous than bears, and in the park their bill of fare is unusually varied by the great variety of waste food thrown out near the hotels. All kinds and conditions of meat are acceptable food to them, cooked vegetables and fruits are generally eaten, and the tin cans, which have contained vegetables or sweets, are carefully licked out. Tin cans, glass, and

trash, however, are no longer put out for the bears, but only wholesome food from the hotels. All fats are considered a delicacy and apparently nothing is wasted in the garbage piles. The native food of the bears is equally as varied. The bones of dead animals are usually picked clean and on rare occasions game animals may be killed, but in most cases these are the sick or crippled, or possibly some of the very young or old that can not escape.

I have never found evidence of bears following or hunting for game animals or birds, although they quickly find a carcass and come to it from a considerable distance. They dig out many mice and ground squirrels and eat the young from the nests. In summer they eat a great deal of green vegetation, including the tops of the cow parsnip, thistles, and other coarse but tender and succulent plants. In many places through the forest their droppings are made up largely of green vegetation. Berries of all kinds are eaten whenever available. In many places along the Lamar River and through the woods along Mist Creek, Fox Creek, and the Upper Yellowstone I found spruces and pines with the bark freshly peeled on one side, from the ground up three or four feet, the wood being well marked with the incisors of the bear where the sweet cambium, or growing tissue under the bark, had been scraped off for food. In some cases the bark had been peeled up to ten feet from the ground and claw marks showed plainly on the trunk of the tree sufficiently high to prove that it was the black and not the grizzly bear that had peeled the tree, although in most cases there was nothing else to indicate which species of bear had been there. I found many spruces peeled in this way and some so recently that I scraped off some of the cambium to see how it tasted. It was sweet and rather pleasant and had a different flavor in different kinds of trees. The spruces (*Picea*) had to me a pleasanter flavor and less of the turpentine taste than did the white-barked or the lodgepole pines, but the bears seemed to show little choice among the three.

Many hollow and rotten logs are found pulled to pieces for ants, beetles, and borers that infest decayed wood, and many of the ant hills are dug open by bears and the ants and their larvæ eaten. Great numbers of stones are turned over for the crawling things that live beneath, and the droppings of the bears are often full of ant and beetle shells and the remains of a great variety of other insects, larvæ, and chrysalids.

In seasons when the little red blueberries are abundant they



FIG. 55. Large black bear photographed in woods.

are a favorite food with the bears and are scraped off, leaves and all, from the low bushes, which are abundant throughout the lodgepole pine forests. Serviceberries, thimbleberries, raspberries, elderberries, bearberries, and currants are eagerly eaten wherever found and the bears are very expert in picking small bits of food from the bushes or from the ground. The rich oily seeds of *Pinus albicaulis* are extensively eaten when the squirrels are cutting off the cones in September.

In autumn the bears usually become very fat, and when the

first deep snows cover up their food supply they hunt for winter quarters in some well excavated hollow under old logs or windfalls, under buildings, in caves among the rocks, or in holes in steep banks, where they may sleep comfortably through the long cold winter, while the snows pile deeper and deeper above them. In hibernation they apparently do not reach the state of deep torpor of the rodents and bats, and when disturbed in mid-winter are easily roused and able to defend themselves. Their vital processes are so reduced, however, that they can live without food for six months and still retain much of their fat for early spring activities. There is yet much to be learned about hibernation.

Usually the bears enter winter quarters late in October and do not re-appear until early in April. Their heavy coats do not reach the greatest perfection until about the beginning of hibernation in the fall and are at the longest and most glossy prime when the bears first emerge from their dens in spring. One that I watched on April 5, 1916, as he came down over the crested snow banks of Mount Everts to feast upon a dead elk in the gulch, looked like a huge black muff, with the glossy sheen of his fur fairly rippling as he walked along the opposite slope of the little ravine.

Bear blazes, bear-marked trees, bear-bitten trees, or challenge trees, as variously called by hunters and woodsmen, are occasionally seen in the forests of the Rocky Mountains and elsewhere. In several places I have noted them along the trails in Yellowstone Park, in Glacier Park, in New Mexico, Texas, and the Adirondacks. Much speculation has grown concerning them but little fact or real observation has been recorded. They are unmistakable when closely observed. A mouthful of bark is bitten off the side of the tree about as high as a man's head—some lower and some higher, according to the size of the bear when standing at full length on his hind feet. Sometimes it is a veritable "blaze," showing a patch of fresh yellow wood with tooth marks scraped across from both sides. That the same

tree is blazed or bitten repeatedly near the same place is shown by old half-grown-over blazes, others a few years old, and still other spots of recent origin. In some cases a side of the first blaze is later bitten out, other blazes of different years show above or below it, and often there are old or recent tooth marks across the dry wood of an old blaze. In some old biting-trees the trunk has been deformed by many years of injury, dating back ten or twenty years or possibly more. There is no evidence of its being done in search of food, pitch, or gum as some have suggested. The food from conifer bark is always sought at the base of the tree, where the bear can sit or stand comfortably while eating.

Audubon and Bachman¹⁴ give an account as if from personal observation of this strange proceeding but offer no clue to its meaning. They say: "At one season a bear may be seen examining the lower part of the trunk of a tree for several minutes with much attention, at the same time looking around and snuffing the air. It then rises on its hind legs, approaches the trunk, embraces it with its forelegs and scratches the bark with teeth and claws for several minutes in continuance. Its jaws clash against each other until a mass of foam runs down on both sides of the mouth. After this it continues its rambles." Whether a sexual expression, a fighting challenge to the next bear that comes along, or a mark that means something to the whole bear population is only conjectural, and again the need of more careful study of animal habits is emphasized.

The mating season is in July or August and the one, two, or rarely three young are born in January or February, while the mother is still in the winter den. The exact date of birth is rarely known. The young are very small at birth, weighing less than a pound each and they develop slowly. The eyes do not open for about forty days and not until over two months old do the young show much activity in the den. In April, usually, they follow the mother out of the den, and then depend

¹⁴ *Quadrupeds of North America*, vol. 3, p. 189, 1854.

upon her protection through that summer and sometimes through a second summer.

In *Yellowstone Nature Notes* for July 1, 1928, ranger naturalist Wayne B. Whitlow reported a nine-year-old female brown bear called Jerry, still nursing her three cubs in June when they were about a year-and-a-half old. They were known to have been with her since the spring of 1927, but whether they had eaten up and taken the food supply of a more recent litter of young or whether the black bear breeds only on alternate years, as is generally supposed, is not positively known. There are cases on record where, in captivity, they have bred regularly each year, but this may have been due to separation of the female and young before the regular mating season began.

The young black bears have very sharp claws and are especially expert in climbing trees, and at the slightest signal from the mother they will rush up the nearest trees and watch for further developments from below. The mother bear is always on the watch for danger, and her suspicions are so easily aroused that it is not advisable to go too near the cubs or to excite her unduly when they are with her, as her maternal anxiety may lead to serious results. If let alone she will quickly take the cubs out of the way and keep them away from any possible harm.

No wild or domestic mother is more vigilant or solicitous for the welfare of her young. Some careful and continuous observations by Frank J. Thompson, superintendent of the Zoölogical Gardens of Cincinnati, are given by C. Hart Merriam in his *Mammals of the Adirondacks* (p. 98, 1884). About the middle of January the female black bear in the society's collection refused to come out of her den into the bear pit and would not allow the male to approach her. She was immediately closed in and furnished abundance of hay with which she proceeded to make a nice warm bed. At four o'clock in the afternoon of January 26, the two young were born, and on the third day the keeper announced that the mother bear would allow him to go into the den. He unlocked the door, fearlessly walked



Courtesy of Giffard for Northern Pacific Railway Co.

FIG. 56. Black bears at garbage near Lake Hotel.

in and began feeding her pieces of bread. By holding the bread just above her head he tempted her to sit up on her haunches so the two young could be seen lying asleep just back of her front paws. They appeared to be less than six inches in length of a dirty whitish color and entirely hairless. In about ten days their coats began to show and were of a grayish tint which gradually passed through various shades until they became a brownish black. Not until the seventy-first day did the youngsters first leave the nest, when one followed the mother to the door. As soon as she found it she drew it gently back, but on its second attempt she cuffed it soundly. After a few days she allowed them to wander about at will, provided no one was immediately in front of the door to the den, but as soon as a visitor put in an appearance they were driven back into the nest and not allowed to come out until the strangers were out of sight.

For some time she suckled them in one position, lying above them on her belly with her legs drawn up under her and her head tucked down between her front paws. This position brought the two breast nipples close down within their reach and covered them from any exposure to cold or observation. As they grew older and began to run about she would sit on her haunches and leaning lazily back against the wall take a cub on each forearm and hold them up to her breasts until they were satisfied. As the young grow taller they can reach their lunch counter by standing erect while the mother sits on her haunches with all the bliss of motherhood showing in her face.

When necessary, however, she can be stern in the good old fashioned way. Thompson says his young bears soon became expert climbers and occasionally would have a regular sparring bout which generally ended in a clinch and fall and regular rough and tumble fight to which the mother would suddenly put a stop by knocking both the contestants completely out of time. In fact he says "as they grew apace the parental visitations increased so rapidly I began to fear she would put an end to my bear investigations by chastizing the life out of them, but of

late she has slackened her visitations and I am in hopes of following the growth of *Ursus americanus* from babyhood to adolescence.”¹⁵

The wholesale destruction of bears over the country at large has so reduced their abundance in unprotected areas that they have disappeared over a great part of their original range. It is especially important, therefore, to have some of these extremely interesting animals preserved in areas where they can be studied and observed under the natural conditions of their wild state.

About the hotels and garbage piles they are comparatively gentle and unafraid and will often let one approach to good camera distance without taking alarm. It should be borne in mind, however, that bears are powerful animals, capable of inflicting serious or fatal injury if angered or unwisely approached. Tourists are discouraged as far as possible from taking risks or cultivating undue familiarity with them. Every precaution is taken to insure the protection of visitors in the park, but tourists often meet bears along the trails or out of reach of the guards and in such cases they should avoid close acquaintance.

Occasionally bears will go into unguarded camps and carry off provisions or tear up and destroy supplies in their search for food, but such accidents are always preventable by proper care and the guarding of camps and supplies.

For weeks at a time I have slept on the ground in front of my tent in various parts of the park, where bears were common and wandering about freely at night, and in no instance have I suffered any unpleasant molestation from them. Because a hungry bear tore open my lunch bag and ate the contents, when my back was turned, was no excuse for complaint or abuse of the bear. When our party of over two hundred Sierra Club members was sleeping on the ground for nearly a month around the trails of the park, a few bears came into camp and quietly helped themselves to food left lying around within reach but they never once showed any aggressiveness. They were always

¹⁵ Forest and Stream, vol. 13, no. 4, p. 605, September 4, 1879.

met half-way with kindly interest and consideration by the well bred and well trained mountaineer disciples of John Muir.

One morning at early dawn one of the young ladies of the party was awakened by a tug at the foot of her sleeping bag and uncovering her eyes saw a large bear standing with his front feet on the foot of the bed. She did not get excited but politely asked him to *shoo*, and he promptly *shooed*.

The few accidents and injuries from bears in the park have been clearly due to foolhardy interference with them by people who had no knowledge or appreciation of bear psychology or habits. A few have been injured by female bears in guarding their cubs and others by bears provoked by teasing or undue familiarity.

M. P. Skinner, former park naturalist, in his delightful book on *Bears in the Yellowstone* (p. 9), says: "For many years at the request of the authorities I have investigated every case of accident with a bear and not once in all that time could I place the blame squarely upon the bear. In a few cases the person was not intending to molest the bear, but even in these instances I felt that the bear had just cause to think that he was."

Black bears in certain parts of the country made serious trouble for the early settlers by killing their pigs and sheep, sometimes eating the green corn in the fields or more rarely some of the fruits and vegetables of the orchards and gardens, or in robbing the bee hives of their stores of honey. In only rare cases has the mischief caused serious losses, but it has reacted in a general feeling of enmity against bruin that has not only helped to wipe him out before the advance of agriculture but has prevented a full appreciation of his value as game and as a meat and fur producer.

In some states bears have been almost exterminated and then with great care and difficulty brought back to areas where they could be protected and maintained in reasonable numbers as game animals. In Pennsylvania, where they are considered the most attractive game in the state, it has been found that they



FIG. 57. Black bears often remain in comfortable tree tops until the coast is clear below.

can be trapped alive and moved from place to place about as readily as domestic stock, their distribution and abundance thus being controlled and most of the local depredations avoided.

Besides their value for food, fur, and oil, they afford a vigorous type of hunting that appeals to sportsmen with sufficient skill and hardihood to overtake and kill this game animal—the most wary, tireless and, at close quarters, even dangerous, left to many of our forest areas. In ever increasing numbers the states are coming to regard these bears as game to be conserved rather than vermin to be exterminated.

YELLOWSTONE PARK BIG GRIZZLY; SILVERTIP

Ursus horribilis imperator Merriam

(Frontispiece)

Of the two and possibly three or four forms of grizzly bears ranging at times into Yellowstone Park this big grizzly, the largest of them all, is the one commonly seen at Yellowstone Canyon, Yellowstone Lake, and Old Faithful. The type was said to have come originally from Mammoth Hot Springs, and was received alive at the National Zoölogical Park in July, 1894, when full-grown and thought to be seven or eight years old. It weighed seven hundred and thirty pounds. It died in the National Zoölogical Park on May 9, 1913, at a probable age of thirty years, and the skin and skull are now in the United States National Museum.

This is one of the largest of the Rocky Mountain grizzlies, the skulls almost equalling in size those of *horribilis* of the northern plains country of Montana and the Dakotas and showing in form and general characters a close relationship. The skull is massive, with powerful dentition. The front claws are very long, arched and light-colored on top. The shoulders are high and well arched. When fully grown these bears are large rangy powerful animals with a swinging stride and rapid motion as well as dignity of action.

In midsummer coats of short hair, their great bodies best show

their powerful muscular build and easy grace of motion; but in the long winter fur, they appear about twice as large as in summer and of great width and height, as well as length and bulk.

The color in the short summer coat of adults is very dark brown, almost black, with a mere trace of gray tipping of the hairs. In summer they might well be called black grizzlies. The yearlings carry their gray winter coats through the summer and are generally in the long silver-tipped fur, in striking contrast to the adults, while the young of the year begin to show considerable gray by the first of August. Late in autumn the adults get the long fur with a beautiful silvery sheen. Age and seasonal changes cause a regular and accountable variation in color, but in no case have I seen a brown grizzly among these great bears of the central high plateau country of the park.

The grizzlies or silvertips are probably more numerous in Yellowstone Park than in any other part of the United States, if not in North America. Those that come to feed about the hotels and camps represent perhaps not more than half of those scattered over the park area. Often three or four, and sometimes seven or nine, are seen at a feeding place at one time and there are records of twenty-four and twenty-nine seen at one time at the Canyon Hotel feeding ground.

Unmistakable tracks and signs of these big bears are often found throughout the deep forests of spruces and pines and over the tops of high ridges and plateaus above timberline of the park region. The huge tracks with marks of the tips of long claws far ahead of the toe prints are easily recognized whether in the park or outside. Some bears wander out to considerable distances and probably some outside bears come into the park. A few are killed each year on the outside. Those that come regularly to the hotel feeding places are less likely to leave the park and are therefore comparatively safe from hunters and any reduction in numbers, so long as they behave in a satisfactory manner.

While much less numerous than the black bears, they are less sociable and less inclined to be mischievous. Also, there is less temptation on the part of visitors to get close to them or to corrupt their manners by hand-feeding or any foolish familiarity. At the feeding places where the grizzlies come, a park ranger with high-power rifle is always stationed in front of the heavy guard wire beyond which the visitors are not allowed, but from back of which they can have a good view of the bears during the evening feeding time, close enough to satisfy most of them. When the dusk deepens and the guard announces that it is time to go, the crowd readily precedes him back to hotels or camps and the bears are left to their own nocturnal devices.

A few black bears come to feed during the day and many come early in the evening so that they are usually on the ground when the grizzlies first arrive at early dusk. But always keenly alert, the blacks catch the first sight, sound, or odor of a grizzly long before we do and at once make off to the forest or wait at the edges of the open spaces until the coast is clear before venturing back to the feast. Sometimes they even climb trees but in any case they take no chance of coming within reach of a hereditary foe. The far greater speed and power of the grizzly is fairly matched by the advantage of better climbing claws of the blacks and perhaps the training of going up a tree at full speed may have its origin in many a close chase. Now, however, the grizzlies rarely deign to notice the blacks at their respectful distances.

At the Canyon Hotel on August 1, 1926, six grizzlies came to the feeding ground in the evening, all in short, almost black summer coats. Twenty-four had been seen there at one time not long before. The next evening at the feeding place back of the tourist camp across the canyon, nine grizzlies came out of the forest and were feeding all at one time. There were two old bears in short dark summer fur, two young of the year, just getting a touch of silvery gray, and five yearlings in beauti-

ful silvery coats. For an hour we sat on the ground back of the wires and watched them feeding and moving about in a quiet way, showing no interest in their two hundred observers and no enmity among themselves, except that a mother and two young kept somewhat apart from the others. At dark we left them still feeding quietly on the scraps thrown out from the camp hotel.

At the feeding place back of Old Faithful Inn on September 5, 1917, an old female with two large cubs appeared at seven in the evening, and a few minutes later two fine old males arrived and for half an hour they all quietly gathered scraps of food, paying no attention to the black bears on the outer edge of the circle or the line of visitors back of the wire. All were in the handsome silver-tipped coats of early autumn and made a thrilling display of beauty and dignity.

Another grizzly in the forest between Lone Star Geyser and Shoshone Lake was seen lying asleep beside a log only a few rods from the trail. As I came opposite he arose to his full height of six feet or more to look at me, sniffing the air, which carried my scent the other way. Apparently his small eyes did not give a clear picture to his mind and he was in doubt as to what kind of an animal was passing. When I spoke to him in low pleasant tones, just a "good morning, old boy," he fell over the log backwards and fairly tore the branches off the trees in trying to get over the top of the ridge and out of sight. Apparently he was not a hotel bear.

A fresh track in the trail to Summit Lake measured six inches across the pad of the front foot on hard ground, where the foot had not spread out nor sunk into the dust or mud, and the claw prints were two or three inches ahead of the toe prints. The bear had followed the trail for a mile or more and in one place had stopped to chew up a lot of white-stemmed pine cones and extract the plump oily nutlets for food, leaving the ragged balls of chewed scales scattered under the tree, where a pine squirrel had cut them off the day before. This is a favorite

food of the bears but to the grizzlies available only through the aid of tree squirrels, as the cones do not fall of their own accord.

At ten thousand feet altitude on the top of Quadrant Mountain, in July, while watching a band of elk feeding over the slopes about me, I saw one of the large blackish grizzlies digging for mice and turning over stones on the slope half a mile to one side. When he finally got through hunting mice, he started over my way in a long swinging walk and soon appeared over the last little rise, in full view of the scattered elk herds. The elk at once began to gather and soon about five hundred of them were bunched up closely, the calves and old bulls in tender velvet antlers in the background and a long line of sturdy cows in the front. They did not seem much alarmed, but faced the bear as he came along and stood their ground while he went swinging by in front of the herd without so much as a glance in their direction. He passed between me and the elk, and his dark coat with its touch of silver and his great size and powerful form proclaimed him a monarch of the mountains. As the bear swung over the top of the hill and disappeared down the other slope, the elk quietly scattered out to other parts of the mountain pasture and the truce of the mountain lords had not been broken.

That an old grizzly is not a safe plaything was shown by one killed near the southeastern corner of the park by Donald Stevenson, one of the Biological Survey predatory-animal hunters. This bear had been known for about seven years, in and out of the park in the Thorofare Creek country, and had killed much stock and some dogs and had been followed in vain by many hunting parties who wanted the two hundred dollar bounty offered for his skin. On October 25, 1917, his track was found in the snow by Stevenson and Clemons. He had swum across Bridger Lake, destroyed a camp, eaten the elk meat, and returned across the lake. After about two hours of tracking he was started and some ineffective running shots were fired at

him. Then the hunters separated, Clemons circling to get ahead of him and Stevenson following the track. After five-and-a-half hours of rapid tracking in a blizzard, Stevenson came upon him in the brush, where he was growling and clicking his teeth at rather close quarters. At first he was obscured by the bushes, but as he charged into the open, Stevenson held his fire until a clear shot could be obtained and planted a twenty-five high-power bullet in the center of his forehead, killing him instantly. The bear dropped within thirty feet of the hunter with the base blown out of his skull, but otherwise a perfect specimen.

This is the finest complete skin and skull of the species to find its way into the National Museum collection, and is in better condition than the actual type specimen, which had been in the National Zoölogical Park for over nineteen years before its death. The fur is long and full, of a general dull blackish color with a frosting of silver-tipped hairs over the back and sides, and yellow-tipped hairs over the head and sides of neck. The nose is dark brown and under each arm is a yellow-brown patch. The legs, belly, and rump are clear black; the long front claws are blackish with white stripes along the tops of the three outer claws on each foot. Unfortunately there was no way of getting his weight but Stevenson in comparing it with the weight of the average pack pony thought it could not be less than eight hundred pounds. The fat was five to six inches thick over the flanks and back and well up toward the shoulders. The fresh skin was estimated at one hundred and twenty-five pounds and with the head made a good pack load for one horse.

The bear's stomach contained only elk meat but in the midst of the hunting season there was no lack of such food to be found and several camps had been recently robbed. The bear had for a long time borne the reputation of a camp robber and a dangerous animal and three bullets were taken from under the skin around his head. There were several other old bullet holes in him but none of the shots had seriously injured or crippled him. Stevenson, who had hunted and trapped grizzly

bears in the Glacier Park country since boyhood, said this was the largest bear he had ever seen.

A possibly larger individual of this species was one from back of Old Faithful, in Yellowstone Park, killed by Arthur Young with one arrow for the group mounted and on exhibition at the California Academy of Sciences in San Francisco. When skinned and cut up in sections this bear weighed nine hundred and sixteen pounds, and Dr. Saxton Pope¹⁶ estimated a loss of nearly ten per cent for blood and waste. This was in May, 1920, and there was scarcely an inch of fat on the bear's back. Obviously he would have weighed much more when he was fat and ready for hibernation.

The food of the grizzly bears in the Yellowstone Park region is fully as varied as that of the black bears, consisting at times of everything that would seem possibly edible within their reach. At the garbage piles they refuse nothing except tin and glass, but seem especially fond of all meats and sweets. In the wild they feed largely on green plants during the midsummer months, especially such juicy vegetation as thistles, cow parsnips, flower stems of bear grass, wild onions, lily bulbs, roots and tubers. As soon as the berries begin to ripen they are eager for strawberries, blueberries, serviceberries, elderberries, currants, gooseberries and even fly honeysuckle. The sweet inner cambium layer of growing spruce, balsam, and pine trees is apparently eaten by grizzlies as well as black bears, but the traces of their work can not always be allocated between the two. Insects and insect larvæ, ants, and a great variety of crawling things are gathered from under stones, bark, or old rotten logs. Huge slabs of rock turned over in the high mountains often mark the trail of a grizzly in search of a breakfast, and the bear sign often shows remains of numerous ants and insect shells. It is generally believed that the grizzly is especially partial to a meat and fish diet, but this is undoubtedly governed by local supply. Any dead animals are eaten if found, and the wide ranging

¹⁶ Pope, Saxton, *Hunting with the Bow and Arrow*, pp. 239-240, 1923.

grizzlies often find such carcasses left from the winter toll, the hunters' leavings and cripples, or from domestic stock killed by poisonous plants, accidents, or by other predatory species. Cattle and sheep are even killed at times by certain individuals that acquire the habit, but little if any wild game can be attributed to their own killing. Marmots, ground squirrels, gophers, mice, and any of the small mammals that they can catch are always acceptable food.

Grizzlies are hearty feeders and become very fat if a suitable food supply is available. With the first heavy snow of late autumn or early winter they go into dens among the rocks, under logs or upturned trees, or in dense thickets to sleep away the winter months. Often they den higher in the mountains than the black bears, going into winter quarters a little earlier and coming out a little later in spring.

Grizzlies usually mate in June or July and the two to four young are born apparently in December or January, while the mother is still in her winter den, and nursed until time to come out in spring when the snow is melting, late in March or early in April. Seton gives the period of gestation as six months and four days. (*Lives of Game Animals*, vol. 2, p. 35, 1926.) Sometimes three or four cubs are seen with a mother and Skinner records five cubs, apparently all of one family, seen with the mother bear on May 15, 1915. Yearling or year-and-a-half-old cubs are often seen with the mother bear and sometimes two-year-olds are still with her, indicating a period of two or sometimes three years between breeding times.

For the first year and at least occasionally for the second winter, the young go into the den and hibernate with the mother, but the conditions and actual habits during hibernation are little known. Are the young corpulent enough to live on their own fat and sleep all winter or are they still nursing? Are they fully torpid at any time or merely soundly sleeping? Are their bodies warm or cold? Are bear stomachs always entirely empty during hibernation as is generally supposed? Do they suck

their paws, or do they hide their noses in their fur as other hibernating species do? Do they ever come out to eat or drink? Are their body temperatures, circulation, respiration and mental processes normal or greatly reduced?

The estimates by Yellowstone Park authorities of sixty grizzlies in the park in 1924, eighty in 1926 and one hundred and forty in 1928 are probably very close to the real numbers. Whether this number should be maintained or increased is a matter for careful consideration by the park officials and easily under their control. There is certainly no greater attraction or interest in native wild animal life offered to the visiting public but it is doubtful if a greater number of bears would add materially to the interest or to the general welfare of the park fauna. While the bears rarely destroy any of the large game animals, they are hearty feeders, and if a scarcity of satisfactory food should occur they might develop hunting habits and even become dangerous enemies of man. A suggestion of what a hungry bear may do is annually shown when the hotels close on September 15 and no more garbage is available for those bears depending upon the regular feeding places. Some hungry bears occasionally break into buildings or camps and become almost frantic in their search for food. It is a question whether food should not be provided for those accustomed to it, to carry them over the short time, about a month, until hibernation naturally begins.

SMALL YELLOWSTONE PARK GRIZZLY; BROWN GRIZZLY

Ursus mirus Merriam

The type of this small brown grizzly is a skull, collected by Henry Anderson on Slough Creek near the northeast corner of the park on March 27, 1915. The skull is so much smaller, lower, and flatter than that of *horribilis* and *imperator* and with such relatively small and differently formed molar teeth that Doctor Merriam considered its closest relationship with *Ursus tablitanicus* of the Stikine region of northwestern British Co-

lumbia, a group of bears quite distinct from the *horribilis* group.

There is no skin accompanying the type skull but apparently this is the small yellow-brown grizzly of the low northern part of the park, several skins of which I have seen, as well as a few of the living bears. A skin at the Hellroaring Cabin, one at the Buffalo Ranch on the Lamar River, and one at Mammoth were of this type but the limits of the range of this bear are wholly unknown. Another skin seen in the Gallatin Valley below the northwest corner of the park was apparently of this bear.

One bear, which I saw swim across Yellowstone River just where it leaves Yellowstone Lake, had every appearance of being this species. Near Mammoth Hot Springs one warm day in July, 1915, I found one of the yellow-brown grizzlies fast asleep on a steep slope in the woods. He was lying in a hollow bed scooped above the base of a big spruce tree and when I put the field glass on him from only fifty feet away I could plainly see his long, slightly curved, light-colored claws, his coarse fur and the ragged remains of his mane. He was not very large, however, and probably would not have weighed over three or four hundred pounds in his thin summer condition, but of course I could not judge of his age. His color was a dirty yellowish brown, except on his throat, nose, and legs, which were in the short, new summer coat of a darker brown. When I threw a pine cone near him he awoke and looked around, but seeing no one quietly went to sleep again, and I left him to finish his nap. Twice more during the day I came back to see if he was there and both times found him still asleep, although at six in the evening he was lying on his back with his feet up against the side of the tree.

Whether the general habits of the two species of grizzlies known to occur in the park differ to any extent is not known, as they have not been sufficiently distinguished for many of the habit notes to be assigned to one or the other. It seems probable, however, that no marked difference is shown, except

such as may result from a difference in type of country occupied. In food habits all are highly omnivorous.

In autumn, if food has been at all adequate, the bears become very fat and with the first heavy snows they hunt their old dens in the timber, well up on the slopes of the mountains. According to old trappers, grizzlies go into winter quarters at higher altitudes than do the black bears and consequently come out later in spring. In the fall of 1915, Cruse Black reported a grizzly feeding on the carcass of a dead buffalo near the Buffalo Ranch after the middle of October, and he also reported two grizzly bear tracks seen near the Buffalo Ranch on April 23, 1913. Up to the middle of March, 1916, no grizzlies had been reported out of their dens, and over on the West Gallatin, just beyond the northwest corner of the park, the hunters were waiting for their appearance up to March 22. Still farther north, in the Sun River country, one was killed on March 18, as it emerged from a winter den that had been previously located and was being watched, but others were still sleeping soundly up to the end of the month. Apparently the hibernation period lasts for about five or six months during the coldest part of the year.

While much has been written on the bears of Yellowstone Park by Seton, Skinner, Heller, and others, a close all-the-year-round study of their habits is still necessary to obtain the desired information on their life histories and details of habits.

INSECT EATERS

DUSKY SHREW

Sorex obscurus obscurus Merriam

These little pointed-nosed animals, smaller than any of the mice, with minute eyes, ears hidden in velvety brown fur, and slender tails a little more than half as long as the head and body, may be recognized as shrews by the long slender flexible noses and the dark brown tips to the teeth. But to distinguish the three species in the park, all of nearly the same size, shape,

and color, the teeth must be critically examined with the lens.¹⁷ The dusky shrews are slightly larger and browner than either the cinereous or the Rocky Mountain shrews, measuring in total length 111; length of tail 46, and length of hind foot 13 millimeters.

Having a wide range over the Rocky Mountain region, the dusky shrews cover practically the whole of Yellowstone Park and specimens have been taken at Mammoth Hot Springs, Snow Pass, Tower Falls, Willow Park, Old Faithful, Shoshone Lake, Flat Mountain, and Astringent Creek.

In habits they are ground dwellers, living mainly under the cover of grass or dense vegetation or under old logs or rock piles, where they either make little burrows and runways of their own or occupy those of the smaller rodents. They are most often caught in traps set for meadow mice in runways that these animals have made under weeds or grass or in wet meadows. A half-eaten meadow mouse is often found in a trap and when it is removed and the trap reset one of these little shrews is usually the next victim. They are eager for any kind of fresh meat, and traps baited with a bit of mouse, chipmunk, bacon, or any kind of meat is likely to catch them. It is possible that they even capture and kill mice much larger than themselves and they probably feed to a considerable extent on young mice found in the nests of various species. The greater part of their food, however, as shown by the examination of their stomach contents, consists of many kinds of insects and other small forms of animal life. These are usually so finely masticated that identification is very difficult, but the minute particles of legs and other hard parts of beetles and various insects are conspicuous.

While voracious little animals and enemies of all animal life even up to those twice their own size, they seem to have few enemies. A strong musky odor renders them unpalatable to the usual mouse-hunting beasts of prey, but occasionally one is

¹⁷ For keys and descriptions of the shrews see *North American Fauna*, no. 51, 1928, by H. H. T. Jackson.

picked up in the trail where a cat or other carnivore has killed it but rejected it as food.

They do not accumulate any noticeable deposits of fat and are active throughout the year, in winter running through their own and other burrows and openings under the snow, often coming to the surface and leaving lines of tiny tracks over the soft white blanket, and burrowing back beneath its surface at will. They seem to be active at any time of the night and day. More probably they have certain periods of activity or else pursue their prey until their appetites are satisfied and then sleep until again hungry. Of their breeding and underground habits much remains to be learned by careful observers with time to devote to such close and interesting studies.

ROCKY MOUNTAIN SHREW

Sorex vagrans monticola Merriam

In size between the dusky and cinereous shrews; possibly a shade grayer and less brown than either. Measurements of type specimen: Total length 107; tail 45; hind foot 12.5 millimeters.

This is a wide-ranging shrew, covering the whole Rocky Mountain region of the United States in Canadian Zone, but there seems to be but a single record for Yellowstone Park, one specimen collected near Mammoth Hot Springs by E. A. Mearns on October 30, 1902. The exact locality was not given but the specimen was with eleven dusky shrews taken at Mammoth and Snow Pass, which showed the direction of his trap line. The species may be expected anywhere in the park.

CINEREOUS SHREW; MASKED SHREW

Sorex cinereus cinereus Kerr, 1792

Sorex personatus I. Geoffroy, 1827

These little shrews are smaller than the dusky or Rocky Mountain shrews but so near in size and color that the teeth are the only safe index to the species. Typical specimens measure: Total length, 98; tail, 40; hind foot, 12 millimeters.

The species is widely distributed over the Rocky Mountain

region, Canada and the northeastern United States in Canadian Zone. One specimen was taken in the park on Mountain Creek by Peter Holt in 1904 and two were collected on Pacific Creek near the southeastern corner of the Park in 1910 by Merritt Cary, and he and Wetmore and Streeter collected a series of eight specimens near Pahaska on the east side of the park. It is probable that they are generally distributed over the region but have largely escaped observation.

In habits as well as appearance they seem similar to the slightly larger dusky shrews, although a careful study may show as radical differences in habits as the teeth show in relationship, for they belong to distinct species, or groups of species, with overlapping ranges and much geographic variation within each group.

MOUNTAIN WATER SHREW

Sorex palustris navigator (Baird)

This largest shrew of the region is of mouse size, or even larger than some of the deer mice, blackish gray above and whitish below, with very small eyes, long nose, tail as long as the head and body, hind feet large with bristle-margined toes and soles like those of the muskrat and other swimming animals, and ears hidden in the dense velvety waterproof fur. Measurements of typical adult: Total length, 152; tail, 78; hind foot 19 millimeters.

Mountain water shrews occupy the higher parts of the whole Rocky Mountain, Cascade, and Sierra Nevada systems in cold streams of the Canadian Zone and probably occur in most of the small streams of Yellowstone Park. Specimens have been taken at Mammoth Hot Springs, Glen Creek, close to the northwest corner of the park, and along Pacific Creek and near Pahaska just south and east of the park line. They are fairly common in most of the surrounding ranges but are rarely seen except when caught in little snap traps set at the water's edge.

Their homes are in the banks of icy streams, cold springs, or ponds, or under old logs or rocks on the banks. The burrows

and runways of meadow mice are evidently used as the little weak claws of the shrews are poorly fitted for digging.

Their large hind feet with fringed margins suggest the swimming feet of the muskrat and they are as much at home in the water as are muskrats, beavers, or otters. They will swim and dive and dart about under water like fish and from above shine like silver from the coat of minute air bubbles carried in their fur, and when they come to the surface they are as dry as if they had never been near the water.

Their food is mainly insects and small forms of animal life, much of which is obtained in the water. They are fond of meat of almost any kind used for trap bait and will often tear up and eat a large part of some mouse caught in a trap near the edge of a stream or pond.

An old female taken near the northwest corner of the park on July 22, 1915, contained five well grown embryos, but of the actual breeding habits of water shrews as well as the details of their food habits very little is known.

In an old concrete reservoir back of Mammoth Hot Springs on the trail that leads up Sepulcher Mountain, I found a water shrew that had fallen in and could not escape. The reservoir contained some four feet of water, but six or eight feet of concrete wall above the surface prevented the animal from getting out or my getting down to help it. It seemed to be enjoying life, however, in its own way. A number of old boards and shingles floated on the water and the shrew would swim among them, dive and stay under water for a minute or two, then come up and run over the boards, picking up small insects that were on them, and feeding so rapidly that its motions were not easily followed. Then it would jump into the water and swim about, puffing its fur and sitting on the surface like a young duck, cleaning its toes and tail, then like a flash diving and darting about as might a silver fish in pursuit of insect prey. Soon it would be back on one board chasing insects or on another particular board feeding on a half-devoured meadow

mouse that was providing a feast of fresh meat, a mouse twice its size that had fallen into the reservoir and either drowned or been killed for food by the hungry little water shrew. With plenty of choice food it was quite happy except when it sat humped up on a board and tried to sleep in the bright sunlight. Its one need was for a home and nest, so I made two large balls of dry grass and dropped them down on the boards, and left the little prisoner to make its own nest, hoping to find it there on my return in a few days. But it was a few weeks before I came back and to my disappointment no signs of the shrew were found. Still, I was grateful for what it had revealed of its habits during my brief visit.

BATS

LONG-EARED BAT

Corynorhinus macrotis pallescens Miller

These long-eared, or jackass bats, are usually found inhabiting the Devils Kitchen at Mammoth Hot Springs, hanging in bunches from the ceiling of the cave or scattered over the walls in dark corners, where they hang by their hooked claws head



FIG. 58. Long-eared bat.

downward during the daylight hours. With a flashlight the long ears can be seen projecting well beyond the nose or curled closely like rams' horns on each side of the head. Two that I caught in my hands had the ears closely coiled, but usually they point forward over the face.

When disturbed, these bats fly about freely in the semi-darkness of the cave until some more secluded place is found in which to suspend themselves. Their long ears projecting for-



FIG. 59. Long-eared bat. These bats are found hanging in the Devils Kitchen at Mammoth Hot Springs during summer.

ward show plainly as they fly about overhead in the cave and can usually be detected as they fly in the early evening outside. When caught in my hands, the bats squealed and bit fiercely at my fingers, but with all their efforts could do no serious harm. On July 11 they were common in the Devils Kitchen and again, on September 18, there were about one hundred hanging from the roof and to the walls. A female taken for a specimen had large mammary glands and had evidently raised one young during the summer. Even at that late date she was not fat, and as

all were very active, the winter hibernation evidently had not begun.

In other caves farther south, these bats have been found in winter in hibernating groups, with their ears tightly coiled and all well supplied with a deposit of oily fat under their skins. Not until the warm spring weather has brought out flying insects do the bats appear in the evenings, and then they may be seen darting about quickly in the dusky twilight, around houses, and trees, and along cliffs and canyon walls.

Their food is mainly, if not all, taken on the wing, and consists of a great variety of moths, beetles, and other flying insects. Unfortunately these are so finely masticated that only with great difficulty can the species be determined. In the droppings that accumulate in great heaps under the roosting places nothing but insect remains are found, and the enormous number of injurious species consumed must class the bats as one of the most useful groups of mammals.

It is a question whether the minute eyes serve any useful purpose in the pursuit of prey, or just what use they are in these wholly nocturnal animals. To a great extent the delicate membranes of the ears and wings serve to guide them in securing their prey.

Judging from a few fragmentary reports, the single large young one appears to be born while the mother is in the cave and is carried clinging to her body until old enough to fly and seek its own insect food. Few places offer a better opportunity for close study of the little known habits of these bats than the Devils Kitchen.

YELLOWSTONE BAT

Myotis lucifugus carissima Thomas

Little dusky bats with gray edges to the tail membranes may be found during the summer months clinging in hundreds to the walls of the Devils Kitchen, and probably they are the most abundant of the small bats seen flying at evening about Mammoth Hot Springs and Gardiner. The type specimen of

this bat was collected at Yellowstone Lake, and the form presumably has a considerable range over the park region, as it has over the surrounding country.

The Devils Kitchen, a large warm cave near Mammoth Hot Springs, is a favorite resort for bats. A well made stairway winds down through its seventy feet of depth and carries one between the rock walls of an old hot spring or geyser orifice. A little light enters from the opening above, but in the dark corners hundreds of these little bats are found back in cracks and crevices over the cold walls of the cave, where they can be reached by hand and picked off and examined at will. They are often in masses of fifty or more, apparently overlapping each other, clinging to the rocks or the bats underneath. When distributed they fly about the cave and light on the walls, but soon crawl back into the cracks and crevices. When taken in the hand they open their mouths wide and squeal and hiss savagely, biting one's fingers, though without doing any noticeable harm. When held gently in the hollow of the hand they soon became quiet and are easily handled.

On July 11, the large number of individuals examined were all females and those taken for specimens each contained one large embryo nearly ready for birth. Each had the usual pair of breast teats on the sides just back of the arm pits. As the bats hang head downward with wings folded in the usual resting position, the young have two soft and safe cradles provided by the folds of the wings, just underneath the two nipples. Even in her flight the mother carries the young one clinging to her body until it is old enough to remain at home in the cave or to fly in quest of its own insect food.

On September 18, when I revisited the Devils Kitchen, the bats had all left, having undoubtedly moved to cooler quarters in which to take their long winter sleep. The blast of warm air that is constantly entering the bottom of this cave would render normal hibernation impossible, and there would not be sufficient insect food to enable the bats to remain active dur-

if properly preserved in strong paper sacks can be made very useful if applied to flower and garden soil or can be sold for fertilizer at a fancy price to green houses or florists.

SILVER-HAIRED BAT

Lasionycteris noctivagans (LeConte)

These large almost black bats have been reported from observations as they flew about in the park, but no specimens have been collected for positive identification. They are almost entirely forest-dwelling bats, inhabiting the higher elevations of

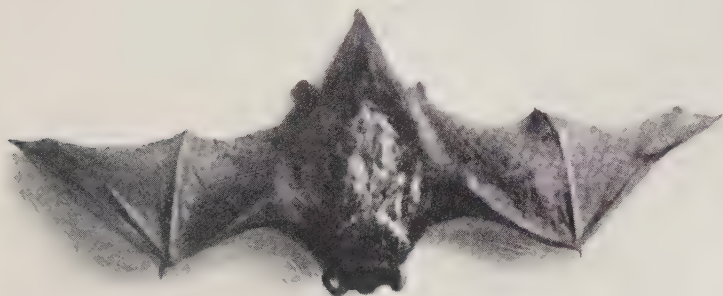


FIG. 60. Silver-haired bat, a summer resident of Canadian Zone forests.

the western mountain region and the northern sections of the United States and the adjacent Canadian provinces. Their very black color often enables one to recognize them even on the wing as they fly rapidly among the trees, but the silvery tips of the hairs over the back are the most distinctive markings.

LARGE BROWN BAT

Eptesicus fuscus fuscus (Beauvois)

No specimens of these large brown bats have been collected in the park, but many of the individuals seen flying about in the

evening over the higher elevations are of its size and general appearance and undoubtedly belong to the species, which is common throughout the adjoining region. To a great extent it is a forest species, living under the bark of trees or in cracks



FIG. 61. Large brown bat, a common summer resident of Transition Zone forests of the Rocky Mountains.

and crevices of buildings during the day, and flying on swift wings in pursuit of its insect prey as soon as twilight has sufficiently deepened.

HOARY BAT

Nycteris cinerea (Beauvois)

Some very large bats seen flying at dusk in the forest areas of the park undoubtedly belonged to this large boreal species, and recently a specimen has been obtained. On the evening of August 30, 1928, one flew into the Information Office at Mammoth and was captured by park ranger Dell W. Cook, and identified by park naturalist Dorr C. Yeager. It is one of the largest of our bats, with an expanse of wings of considerably over a foot and often reaching to fifteen or sixteen inches. Its

heavy body, short rounded ears, and the hoary gray tips of the yellow-brown fur mark it as a very conspicuous and a unique type of bat. It is one of the well known migratory species, breeding in the boreal forests of the north and the high mountain regions, and in autumn making long flights to the southward in quest of suitable winter quarters.

CHAPTER IV

BIRDS OF YELLOWSTONE PARK

THE BIRDS in many places in the park are as gentle and confiding as the mammals and may be enjoyed at close range by those who know how to win their confidence and friendship. The flocks of *Canada geese* that, outside of the park, could not be approached within rifle range, will merely walk out of the road to let you pass or feed quietly in the bright flower meadows near the lakes or streams where you stop for lunch. Skinner's¹⁸ estimate of four hundred pairs breeding each year in the park seems not too high and these may help to save the species from eventual extinction if we awaken in time to the necessity of giving them a safe winter refuge somewhere farther south. Who would not go a thousand miles to be awakened in the morning by a flock of these spirited honkers or to meet one of our wisest and wariest of game birds on friendly terms and see the watchful parents leading their broods of awkward goslings over the meadows?

A few of the rare *trumpeter swans* breed each year on some of the larger lakes in the park and seem to be slowly increasing on this their last stand in the United States. With one or two other breeding flocks in Canada they may yet bring back the species from the brink of extinction and save our civilization from the disgrace of exterminating one more of our magnificent species. Skinner has reported these swans on Yellowstone Lake, Heart Lake, and a nest in a pond near Lewis Lake.

¹⁸ Skinner, Milton Philo. The Birds of Yellowstone National Park; Roosevelt Wild Life Bulletin, Syracuse University, New York State College of Forestry, vol. 3, no. 1, pp. 1-192, 1925.



FIG. 62. A flock of contented Canada geese.



FIG. 63. Trumpeter swans in National Zoölogical Park.

In 1915, I saw two on Lewis Lake and, when with the Sierra Club on a round of the park trails in July, 1926, found one lone swan on Shoshone Lake, a pair with six half-grown young on Bridger Lake and a pair with one half-grown young on a pond near the shore of Yellowstone Lake. A few are reported each year in *Yellowstone Nature Notes* and the number seems to show a slight increase, although not what it should be. A careful study may show that the pair of bald eagles nesting in a tall pine on the shore of Shoshone Lake have taken the increase from the pair of swans that have nested there, as our observations in 1926 strongly suggest. The coyotes whose tracks patrolled the shores of the pond at the northeast corner of Yellowstone Lake probably also account for the disappearance of all but one of the brood of young swans found there in July, 1926. Such conditions can be easily remedied if we are sure of the facts, and what better service could a competent ornithologist render the country at large than to spend a summer or several summers quietly watching these birds night and day to learn more fully their habits and needs.

A few of the rapidly vanishing *sandhill cranes* still nest in the park each summer, and if protected outside on their migratory journeys may some day save the species from total extinction. This is now one of the few places where these stately birds can be seen in summer, and their spirited bugle call can be heard from the big marshes or open spaces, a call as inspiring as the trumpeting of the swans or the honking of the Canada geese. Like the swans and the geese they once covered the country in great numbers, but in like manner they have rapidly melted away before the gunfire of so-called sportsmen. If we are to bring back these glorious birds it can nowhere be done to better advantage than here on their natural breeding grounds in Yellowstone Park. A coyote den near a nest would be fatal, but that is a condition that is unnecessary, and the birds have comparatively few other enemies to trouble them and should steadily increase in numbers.

The great white *whooping crane* is gone, probably forever, with only one old record for the park.

White pelicans breed in considerable numbers on Molly Island in Yellowstone Lake, and all summer they may be seen on the lake or on the river above and below the Fishing Bridge, floating like white ships on the smooth waters or circling in spectacular formation against the blue sky. Often they swim so close to the observer that their method of catching fish with their great pouched bills can be studied or they may be watched as they line up on the beaches for an after-dinner siesta. Occasionally they are seen on some of the other large lakes or on some of the rivers in the park, but Yellowstone Lake is their central summer home.

California gulls breed on the islands in Yellowstone Lake and may often be seen in flocks along the shores and at their regular feeding places, where garbage is put out for the bears. A not unfriendly rivalry is shown by the gulls and bears in getting first choice of the titbits from the hotel kitchen, but the gulls keep just out of the way of the bears. Below the Fishing Bridge they quickly gather when fish are cleaned, and scramble eagerly for the refuse thrown out. They also catch some of their own fish and perform a useful service in cleaning up any dead fish found along the lake shores.

A few *ring-billed gulls* are seen along the shores of Yellowstone Lake and rarely a few of the great black-crested *Caspian terns*, graceful birds that add beauty to a beautiful shoreline.

The *common loon* is uncommon in the park but occasionally one or two are seen on some of the larger lakes, or their wild cry is heard from far over the water or from high in the sky. It is one of the unforgettable thrilling sounds of nature, inspiring to every real woodsman or lover of the great out-of-doors. The loons may already breed in the park, but if not they surely will when some pair of birds are driven from their home outside and are forced to come to these quiet protected lakes for safety.

Eared grebes swim and dive on the lakes and breed in the ponds and along reedy shores as one of the common summer residents of the park. Their floating raftlike nests are generally anchored by a few tules or grass stems to keep them in place until the young hatch and swim away, to follow the mother birds in small family parties.

A few of the great silvery throated *western*, or *swan*, *grebes* visit the park lakes in migration, but apparently do not remain to breed. Largest and most graceful of our grebes, when once seen they will always be remembered.

Last and least of the grebes found here are the little *dab-chicks* or *hell-divers*, found occasionally on the ponds or smaller lakes during the summer, but so shy and wary that they are not often seen.

A long list of ducks, recorded from the park, is largely of migrating species that stop briefly on their way north or south, but a considerable number remain to breed, and a few spend the winter as well as the summer in the park. On the larger lakes the *sheldrakes* or *American mergansers* are generally the most abundant ducks, seen singly or in pairs or with large families of young following their leaders. Expert divers and fishers, these ducks find most of their food under water, but in spite of all the study given them we do not know half enough of their food and feeding habits and can not always tell whether they are useful or injurious to the interests of the human angler, whether they are too numerous or whether in just the right numbers to control some delicate adjustment of fish life in the big deep lakes and along the swift rivers, where a few remain all winter.

The *red-breasted* and *hooded mergansers*, also in part fish eaters, are comparatively rare visitors in spring or summer.

Barrow's goldeneye is, next to the mergansers, probably the most abundant and conspicuous duck on the deep lakes of the park, seen during the summer in pairs or family parties with small broods of four to eight young. Generally their nesting

places are in hollow trees, but a hollow tree is so rare in the park forests that they must be forced to take some other shelter for their eggs, possibly among the rocks or in holes in banks. What a chance for some ornithologist with a little leisure to settle this problem that has puzzled so many for so long and to make a real contribution to ornithology. The same problem as to the nesting site of the sheldrakes is still unsolved.



Photo by Edward A. Preble
Courtesy of U. S. Biological Survey

FIG. 64. Male Richardson's grouse hooting in spring. Near Jackson, Wyoming.

The *American goldeneye*, with a crescentic instead of a circular white spot on the cheek of the males, is reported as a winter resident of the park but is not known to remain to breed.

The *Pacific harlequin*, a gaily marked little river duck of the far north, rare in the high mountains of this region, seems to be almost if not quite a regular summer resident along the rapids of Yellowstone River below the lake. On several trips I have seen them there, buffeting the foamy waters or resting on boulders in the river, bobbing down through swift rapids and

flying back to do it again, just for pure joy of the rough waters. Their nest has not yet been found in the park, but they breed in Glacier National Park and someone will some day surely find them breeding here. Some of the birds on the river, July 30, were apparently young of the year and at this season they ought not to be far from home.

Of the commoner ducks, *mallards*, *gadwalls*, and *blue-winged*



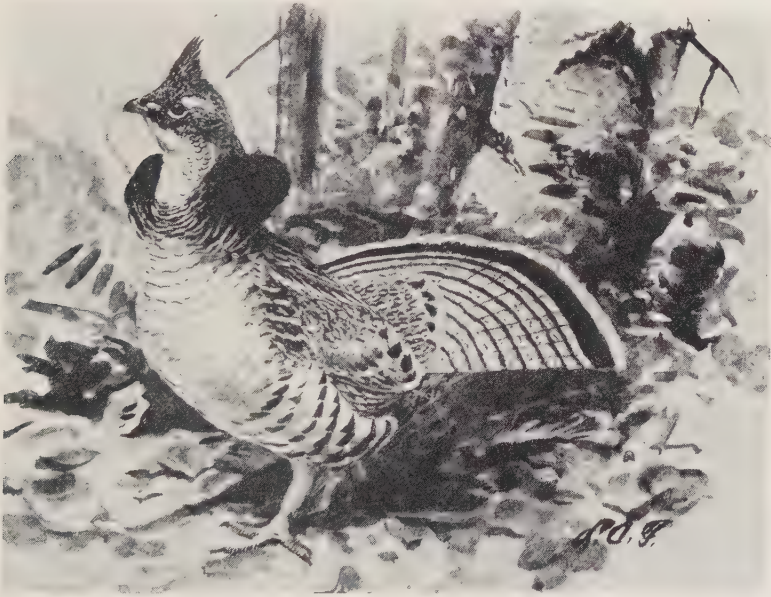
Photo by Edward A. Preble
Courtesy of U. S. Biological Survey

FIG. 65. Male Richardson's grouse hooting in spring near Jackson, Wyoming.

and *green-winged teal* are found, often with families of young, along the quiet streams or in marsh-bordered ponds where food and shelter are to their liking. A few, especially of the mallards, stay all winter in the spring-fed streams or warm rivers that do not freeze, but most of the ducks raised in the park migrate over long and dangerous lines before returning to their safe breeding grounds, where their tameness is often surprising.

The *great blue heron* may occasionally be seen along any of

the streams and lake shores or in marshes, where frogs or minnows are found. They are usually solitary, silent, and watchful, apparently wanderers from their breeding grounds lower down in the valley country. With broad wings and long legs and necks they look almost as large as sandhill cranes, but their very light bodies offer little temptation to the hunter of game and they show little decline in numbers.



Courtesy of U. S. Biological Survey

FIG. 66. Male gray ruffed grouse in breeding plumage.

Coots and *sora rails* are found in ponds and marshes during summer, but must be looked for, or listened for, to be located. The coots nest in shallow water along the margins of the ponds and the rails on dry ground under cover of tall marsh grasses.

Many shorebirds visit the park, especially in late summer, after the breeding season is over in the far north, but comparatively few breed in the park. The *killdeer* and *spotted sandpiper* are abundant breeders and add much to the interest of



Photo by E. S. Cameron

FIG. 67. Columbia sharp-tailed grouse.



Courtesy of U. S. Biological Survey

FIG. 68. Sage grouse, male and female in spring.

summer bird life. The *Wilson's snipe* undoubtedly breeds in the park and a few others may be found breeding when more detailed study of the birds is made. A few *black-bellied plovers* in dull winter coats were reported by Skinner on Alum Creek near its junction with Yellowstone River above the canyon on September 24 to 26, 1926. This was at seven thousand eight hundred feet altitude in zero weather and the birds were on their long migration from breeding grounds in the Arctic to winter range in South America. They are considered rare birds in Wyoming and especially at this high altitude (Condor, vol. 29, no. 4, p. 203, 1927).

Richardson's grouse and the *gray ruffed grouse* are common residents and breeders over the whole of the timbered parts of the park but are not as abundant as they would be were the small carnivores less common. Nevertheless they are holding their own, and during the summer months families of young birds are often seen following their mothers along the trails. They show little fear of man, and interesting accounts of their coming about houses and camps for food and protection have appeared in recent *Yellowstone Nature Notes*. In the number for February 1, 1928, the park naturalist reported two Richardson's grouse making themselves at home as residents of Mammoth village. They are less afraid than the average domestic chickens, walking about the porches and doorsteps while people pass back and forth within a few feet of them. During the daytime, when not feeding, they spend much of their time under the porches and at night they go up into the branches of near-by pines to roost. Their usual note is a low call, a kind of purring cluck, that seems to express a full measure of contentment, well being and good will, accompanying as it does their slow measured steps as they walk about at your feet. Because of their fearlessness in general these grouse are often called "fool-hens," implying that any bird not wise enough to keep out of man's reach must be a fool. About the park settlements, however, this foolishness becomes real wisdom, for nowhere else could



Courtesy of U. S. Biological Survey

FIG. 69. Bald Eagle

they be so safe from their natural enemies, coyotes, foxes, martens, and weasels, as in close proximity to man. When an unfailing food supply is also provided, their peace and prosperity are assured and their confidence fully won.

A few *sage grouse* and *sharp-tailed grouse* have been reported in the lower part of the Yellowstone and Lamar River valleys, but they are scarce, if they occur there at all at the present time. The little *Franklin's grouse* has also been reported in the timber of the park but it is a rare bird so far south.

Skinner records a single *white-tailed ptarmigan* seen on the open top of Quadrant Mountain above timberline and about half a mile from the nearest trees. (Condor, p. 204, 1927). This is a first record for Yellowstone Park but the birds were reported from the west side of the Teton Mountains in 1910 by T. R. Wilson, and they occur commonly in the Medicine Bow Mountains of southern Wyoming.

Hawks, owls, ospreys, and eagles are generally abundant in the park, attracted by the ample food supply and by freedom from persecution by man. *Bald eagles* nest in a few localities and are generally found over the park from early spring to late autumn and a few all winter. A nest in a tall pine on the northeast shore of Shoshone Lake contained one full-grown young on July 16, 1926, and old eagles were seen at several places in the park during the summer. Usually a few hang around Yellowstone Lake during the summer and live on dead fish found along the shores or on freshly caught fish taken away from the ospreys. On one occasion I saw a fine old white-headed eagle catch a fish in the river below Yellowstone Lake, but he made a sorry job of it and had to flop to the shore on wet wings, dragging the fish in his claws until he climbed out on the bank with it. To what extent these birds prey upon small game or young of the large game animals is not well known.

Golden eagles are occasionally seen in the park but they are less common than the bald eagles and may or may not nest in the park. They are more often seen around the peaks and cliffs,

and undoubtedly obtain some of the young mountain sheep and deer, and possibly some of the larger game birds as in other parts of the Rocky Mountain region. Park rangers Douglas and Mills in December, 1928, reported one near Terrace Lake eating a Canada goose. Too many of these noble birds would not be desirable in a wild life park but the few found here may be counted a welcome addition to the avifauna.

Ospreys are conspicuous birds of Yellowstone Park, whether diving into the lakes and rivers for fish and carrying them wiggling to lofty nests of hungry young on top of tall trees or on pinnacles and towers of the canyon walls, or soaring on long narrow crooked wings over the water watching for finny victims below the surface. Their squealy voices are often heard and are wildly shrill when they are pursued by some hungry bald eagle, pouncing upon them from above until the precious fish they carry is dropped and gracefully caught by the big pirate of the air. Then the osprey is free to go back and hunt for another fish and again run the gauntlet in carrying it home to hungry young. Fortunately the limited number of eagles take only a royal tribute of the fish thus caught and do not actually starve the toiling ospreys or their offspring.

Many other hawks, little and big, are seen over the park through the summer but none is more in evidence than the little *desert sparrow hawk*, seen everywhere in open country along the roads, on fences and telephone poles, or fluttering over the grass in search of grasshoppers and meadow mice; a wholly useful and wholly harmless friend of man.

An occasional *prairie falcon* may be seen, and a pair of *duck hawks* have been reported nesting in the lower end of Yellowstone Canyon. Big *western red-tails*, *Swainson's hawk*, and the still larger *ferruginous rough-legged hawk* are common summer residents and breeders in the park, all of them useful in controlling the abundance of ground squirrels, mice, and gophers, while practically harmless to the bird and small game population.

An occasional *western goshawk*, a few *Cooper's hawks* and

sharp-shinned hawks are found in the park, all primarily bird killing species and, especially the goshawks, partial to grouse and game birds generally. These three species will bear watching, particularly where coveys of young grouse are trying to grow up and have not learned to take shelter under a friendly porch. An occasional hawk will do little harm, but where any of these three locate their nests no other birds are safe in the vicinity.

A few *marsh hawks* hunt over the marshes and open grassy slopes, in search of mice, but also take any ground squirrels or small mammals they can pick up and rarely a few ground birds. Generally, in such regions as this, they are counted useful hawks.

Of the several species of owls found in the park the *western great horned owl* is the commonest and most important, breeding in cliffs and canyons and also in hollow trees or in old hawks' nests over the region at large. They are powerful night prowlers and with hungry broods to feed they gather up any small game that comes their way. Generally, however, meadow mice and other rodents form a great part of their food so they can be classed as useful birds except where game birds and poultry can be found near their nesting grounds. Their deep mellow *hoo, hoo, hoo, hoo-oo-oo* is one of the stirring night songs of the canyons and forests.

The little *Rocky Mountain screech owl* is occasionally seen or heard and probably is more common in the park than we are led to believe. A very useful little mouser, he is so quiet that were it not for his quavering call we would rarely know of his presence or realize that he was about, although we might be sleeping under his very own roof tree. The *Rocky Mountain pygmy owl*, the *short-eared* and the *long-eared owls*, the rare northern *hawk owl*, have all been reported in the park, but our knowledge of their status there is very limited.

Kingfishers may be seen or their rattle heard over almost any lake or stream in the park. Skillful fishermen, they find abundance of food in the small fry of the park waters, but how much

of their daily fare consists of young trout and how much of worthless minnows, water insects, crawfish, frogs, and other small animal life is not well known. While some of the fishermen may look askance at these rivals, few would be willing to spare their cheerful presence along lonely streams or grudge the pleasure they afford to the thousands who do not stop to catch fish but can always see the birds. The nesting holes of the kingfishers are dug far back into the banks of streams or steep sandy banks not far from good fishing waters. Many nest holes can be seen in the banks along Gardiner River halfway between Gardiner and Mammoth. The kingfishers stay here all the year around, getting plenty of food in winter from the open water of the warm river, and probably sleeping at night in their deep nest holes. I never did get up early enough in the morning to catch them napping, but some one ought to watch them and time them coming out and going in, to prove whether or not they do use these nest holes as sleeping quarters, a habit apparently not recorded but one that would be of considerable importance to the birds.

The park is well supplied with woodpeckers as a forest region must needs be for its best welfare. *Arctic* and *alpine three-toed woodpeckers* are found all summer, often with nests or families of young ones, and apparently both kinds remain throughout the winter, or merely drop down to lower levels during severe weather. The solid black back and orange crown patch mark the *arctic* and the broad white stripe down the back of the *arctic* may at first suggest the *Rocky Mountain hairy woodpecker*, from which it can be distinguished by less white, the orange crown patch of the male and by the three instead of four toes, two in front and one behind. The *alpine three-toed* nests throughout the Canadian Zone forest but the *arctic* is more generally found in the dwarf timber of Hudsonian Zone. Both are bark scaling birds, getting more of their food by prying off the old scales of spruce trees to find the eggs and larvae of insects than by hard chiseling into the solid wood for borers.

Who can ever know the benefit to forest timber of this destruction of myriads of insects in winter or in the summer nesting season from the big mouthfuls of insects brought all day in rapid succession by both males and females to feed their broods of hungry growing young? They are gentle birds, easily watched while at work but usually too busy to give much attention to visitors.

The *Rocky Mountain hairy woodpecker* with his white breast, white-striped black back, and bright red head-band, and the very similar appearing but half-sized *Batchelder's woodpecker*, are found practically all over the park, summer and winter, some of them drifting below at times of severe weather, but rarely going far from their comfortable winter homes, chiseled out of the forest trees, or from their home feeding-grounds in the forest. In winter they often come to camps or houses, where some food may be salvaged from the garbage, and always seem appreciative of a piece of suet or a meat bone nailed to a tree to supplement their hard-earned fare of frozen wood borers, eggs, and larvae excavated from the trees. They soon become regular visitors and well repay kindly attention with cheerful chatter that means much to the lonely mountain dwellers who care for these wild creatures of the woods. Who could have better friends or more useful neighbors?

The *red-naped* and *Williamson's sapsuckers* are common summer residents and breeders over the park, mainly in Canadian Zone timber. Their nests are occasionally found, their squeaky voices and their light *tap tap* on the tree trunks often heard. Even more often are seen the circles of holes cut just through the bark of live trees, balsams, young pines, aspens, alders, birch or willows, made in quest of juicy inner bark or cambium, sap, or insects. Sometimes these circles of shallow pits are so close together as to deform or kill a branch or section of the tree and in some types of forest do real harm, but here they are only interesting records of the work of the beautiful birds, which after all get much of their food from the tree-dwelling insects.

Red-shafted flickers are probably the most abundant woodpeckers in the park, or at least the most often seen. They keep much in the open and are seen on the ground, feeding on ants and sometimes catching grasshoppers or other ground-dwelling insects. Their orange-red quills make them more brilliant birds than our eastern golden-winged woodpeckers, to which they are very similar in voice and general habits. In fact the hybrids between the eastern and western forms have been taken in central Montana so near-by that they might well occur in the park.

The big black-backed and red-bellied *Lewis's woodpeckers* are occasionally seen in summer along the Gardiner and Yellowstone rivers at the northern edge of the park and may even nest there, but they seem to be only casual visitors.

Also an occasional *red-headed woodpecker* is seen in the low valleys of the Gardiner and Yellowstone rivers and may occasionally breed, for they are common breeders a little farther down the valley at Livingston and Billings. They are not likely to be found above Transition Zone.

Pacific nighthawks nest in the park and late in July or in August are often seen in great numbers hawking over the open spaces as they gather for their early southward migration. Much of their journey seems to be of a leisurely type, made during daylight hours with frequent stops for feeding and resting along the way.

Of the bright little hummingbirds seen buzzing around the park flowers, a few may be recognized as the *rufous* and the *broad-tailed*, but more often they will prove to be the tiny *calliope*, which breeds all through this part of the Rocky Mountains. Only by close and quiet study can one get much enjoyment out of these jewels of the bird world, and only by locating certain types of honey-laden flowers can they be found sufficiently busy to be studied close by. Their tiny nests are protectively colored, lichen-covered cups, so small and well concealed that they are rarely found. No human fingers could fashion such exquisite receptacles for the two pearly eggs.

The *eastern kingbirds* occur more or less regularly in the northern part of the park in the low valleys of the Yellowstone and Gardiner rivers and may breed, as they do commonly lower down the valley of the Yellowstone. One *Arkansas kingbird*, seen by M. P. Skinner in the Upper Geyser Basin on August 30, 1926, gives an unusually high altitude record for the species which is common in the lower valleys north and south of the park.

Say's phoebe also occurs here and may breed, while the *western wood pewee* is common in the low parts of the park and occasionally over the higher plateau top in summer.

Of the four little flycatchers reported in the park only the *Wright's* is considered a common breeder.

Of the four forms of horned larks found at various times and places in the park, the *desert horned lark* is the common summer resident and breeding bird, often found in the most open and arid sections, on dry mesa-tops or well grazed ridges, singing and courting in the early springtime, and later busily feeding fuzzy young in the nests or along the little-used wagon roads.

A few *black-billed magpies* are found in the low valleys of the Gardiner and Yellowstone rivers at all seasons and in winter Skinner reports them more generally scattered over the park. A few old magpie nests in the willows along Slough Creek and Lamar River show these valleys to be within their breeding range. Though beautiful and intelligent birds, they have fairly won the enmity of ranchmen outside, but here in the park, in their present numbers, they can do little damage. If they should greatly increase, the eggs of grouse and other game birds might suffer undue losses.

Western crows and *ravens* are generally distributed over the park wherever a food supply is available. Apparently ravens have decreased in numbers since the lessened kill of the wolves has cut down their regular meat supply, but they will always bear watching.

The tall crest and dark blue back and tail of the *black-headed*

jay or his harsh scream are occasionally recognized in the deep forest or around some old camp site. The birds are surprisingly scarce, however, through the park; so much so that the sight of one is a rare treat.

The soft-winged, talkative Rocky Mountain form of the *Canada jay* is a fairly common bird in the forest or around the camps, summer or winter, and a more friendly or confiding bird could not be found. Gentle and responsive as chickadees, they will answer you back, near and far, if you whistle their soft notes, and will usually come when called, especially if some food is expected. Meat or tallow, nuts, bread, or pancakes are gratefully accepted, and if given a feeding table with scraps of food of any kind they soon learn the time for meals, and rarely miss one. Generally much of the food is carried away and cached in the tree tops for future use and often carried again to safer places. There are no more appreciative or delightful winter friends in the park.

The plain blue *pinyon jays* occasionally come into the low valley at the northern edge of the park, appearing in small flocks with soft calls and level flight. Their crestless heads, short tails, and blue coats distinguish them at close range and their plaintive call in the distance.

Clark's nutcrackers, big, boisterous, black, gray and white birds, with harsh, rasping calls are often conspicuous around Mammoth Hot Springs, where the limber pines yield big seeds to their liking, or along the high ridges and peaks in Hudsonian Zone where the nutlike seeds of the white-barked pine yield their best food supply. Formerly we thought them purely Hudsonian Zone birds, they kept so close to the stunted timberline trees all summer, often accompanied by families of young, but Skinner has found them breeding at Mammoth in Transition Zone, nesting in February at the coldest part of the year, with deep snow on the ground and often with fierce storms raging. Their rough but thick warm nests of twigs, straws, and bark, well lined with fine soft materials, afford good protection for

eggs and young at such times, while the heavy winter feathers of the mother bird, with her constant care, complete the protection of the young ones so that a little later broods of husky fledglings are following their parents abroad.

A few *thick-billed redwings* and pompous *yellow-headed blackbirds* breed in grassy-bordered ponds in the park, but the trim blue-black and white-eyed *Brewer's blackbirds* are the commonest of this group, breeding all through the sagebrush country not far from water or marshes. Later in summer they gather in great flocks wherever scattered grain or grasshoppers are to be found.

A few *cowbirds* follow the horse herds and along the Upper Yellowstone River often came into camp, riding on our horses' backs. There would be an unusual opportunity here to study their habits in relation to the buffalo herds, and possibly verify the theory that the migratory habits of these plains cattle were the original cause of the cowbirds' shirking their parental duties and leaving their eggs to be hatched by other birds with stable homes.

The *western meadowlarks*, with their spirited uplifting songs, are one of the joys of the park, singing as they do in every meadow or open glade. A more wholesome, more wholly useful, and more delightful bird would be hard to find.

Of the large sparrow family, the grosbeaks are the largest and perhaps most attractive. The richly colored yellow, black, and white *Rocky Mountain evening grosbeaks* are often heard in pairs, or small flocks, flying from one tall tree top to another with sharp metallic chirps that once heard are unmistakable. They occur mainly in the low valleys at the north edge of the park, being especially Transition Zone breeders in the mountains. While camping at Yanceys old stage station in July, 1915, I heard them almost daily, and they have been reported about Mammoth and Gardiner and probably have a much wider range. For rare and interesting birds few can be found whose close study promises more important results.

Rocky Mountain pine grosbeaks are among the scarce, though not rare, residents of the park forest. In summer they are generally found in Hudsonian Zone, where they breed, but in winter they come down to lower levels and sometimes around camps and ranches. Generally they are found in pairs or small family parties, their slaty gray plumage brightened in the old male by a wash of pink or carmine-red, and in the female and young by dull orange over the head and back. They are among the gentlest and most friendly of the mountain birds, usually showing little fear of man as they gather their food of seeds and insects from the tree tops or occasionally drop down to feed on the ground.

Black-headed grosbeaks occasionally come into the low valley above Gardiner but are not often seen even as high up as this.

The *Cassin's purple finches* are fairly common summer birds of the park, and the male with a crimson crown patch and pinkish purple wash over head, neck, back and breast is easily recognized, while the dull streaked female might pass for some plain-colored sparrow. Their rich finch song from the tree tops, however, is unmistakable and one of the rare pleasures of the forest.

Crossbills are fairly common in the park and are usually recognized by the quick sharp flight notes as small flocks pass overhead from tip to tip of the tall spruces, where their favorite seeds are deftly extracted by the crossed mandibles from between the scales of the cones. On rare occasions they are seen on the ground picking gravel, or at waterholes getting a drink, but usually they are tree-top birds. The *white-winged crossbills* have also been reported from the park and if seen are easily recognized by the two white wing-bars, lacking in the red crossbills. In voice and habits the two are very similar.

THE ROSY FINCHES

The *black rosy finch* is undoubtedly one of the common breeding birds on many of the high peaks in Yellowstone Park, but



Painting by Olaus J. Marie

FIG. 70. The Three Rosy Finches of Yellowstone Park

Hepburn Rosy Finch
Male

Gray-crowned Rosy Finch
Male

Black Rosy Finch
Female

Male

its nests have never been found nearer than on some of the high peaks of the Absaroka Range, a little east of the park line. Here in the early part of July, 1910, the first nesting sites ever located were discovered by Merritt Cary, Alexander Wetmore, and D. D. Streeter. The finches were then common between ten thousand and eleven thousand feet altitude on the slopes of Needle Mountain and Whirlwind Peak where they were breeding among the rocks above timberline. Some of the females were evidently laying eggs and others, found a little later, were feeding young ones just out of the nests.

Not until fourteen years later were the first nests and eggs of these birds found. Then Frederic W. Miller visited this same region and at eleven thousand five hundred and eleven thousand eight hundred feet on high peaks of the Wapiti Ridge actually collected sets of fresh eggs, on July 1, and 6, and a well incubated set of five eggs on July 10, 1924. The almost inaccessible location of these nests would readily account for the fact that they had not been previously discovered, and should lend zest to a more detailed study of the nesting habits of these remarkable birds along the higher parts of the Absaroka Range and a search for other peaks where they may breed. In the Electric Peak group of snow-clad mountains west of Mammoth, on July 11, 1915, I found two of these rosy finches perched on a tree near the trail at nine thousand feet in Fawn Creek Pass, on the south slope of Gray Peak. This in the midst of the breeding season would indicate breeding grounds higher up on these peaks which are now included within the park boundaries.

Also, in the Teton Mountains, Wetmore and Cary found both old and young birds common at timberline on August 30, 1910, and in the middle of July, 1926, old birds were seen by members of the Sierra Club above timberline on the highest peaks of the Tetons.

Apparently there is no need to look for the nests of these birds until one is well up among permanent snowbanks, and even here they appear to be quite generally in entirely in-

accessible locations. Miller found the nests on Citadel and Ptarmigan peaks of the Absaroka Range a thousand feet above extreme timberline, although the old birds were found feeding lower down, even to the edge of timber.

The nests were located in well protected cavities of the cliffs from four to forty feet above the slide rock and in one case were reached only by a long rope lowered from above.

The nest is described as a loosely woven structure of fine grass and plant stems reënforced with moss and lined with marmot fur, mountain sheep wool, and a few rosy finch feathers.

The four or five eggs in each of the three nests found showed a pinkish tinge while fresh and unblown but were pure white when empty of contents. This is an unusual color for the eggs of any of the sparrow family, but the usual color of eggs of any birds laid in dark holes or covered retreats. Great credit is due to Frederic W. Miller and his companion, Capt. F. E. D'Amour, for their difficult and dangerous studies, which have made known to us some of the secrets of the home life of these remarkable birds.¹⁹

The general range of the black rosy finch is given as northern Rocky Mountains, south in winter to New Mexico and Arizona. Young birds have been taken in the Uinta and Wind River mountains in Wyoming and the Salmon River Mountains in Idaho but the actual breeding range is little known.

In winter they are usually found with flocks of gray-crowned rosy finches in the valleys of Wyoming, Montana, Idaho, Utah, and Colorado, and in general habits the two seem to be much the same, highly gregarious and very gentle birds. During stormy or snowy times they often gather about strawstacks, feed grounds, or barns and ranch buildings, seeking food and shelter from the storms. In Yellowstone Park, Skinner²⁰ says the three

¹⁹ Miller, Frederic W., *The Nest and Eggs of the Black Rosy Finch*, Condor, vol. 27, pp. 3-7, January 15, 1925.

²⁰ Skinner, Milton P., *Birds of Yellowstone National Park*, Roosevelt Wild Life Bull., vol. 3, no. 1, p. 84, 1925.

rosy finches, the gray-crowned, black, and Hepburn's, may be seen almost anywhere at the opening of winter but especially at Mammoth Hot Springs when severe storms drive them down about the stables. In fact I have seen them in the stables at Mammoth as well as at some of the ranches in the lower valleys and they occasionally fly into houses if during a storm a door is left open for a moment.

In winter the rosy finches have only a cheerful twitter besides their little talking notes among themselves but even in the breeding season their song is said to be a feeble effort. Wetmore says they have a call note like that of the mountain bluebird, a *chur-r-r-r* and a twittering song. Miller says their song is powerful but harsh, often ending in a number of sharp, sparrowlike notes, but he also adds that, despite its unmusical quality, it is a welcome sound in the high bleak areas where bird voices are so seldom heard.

Their food in winter apparently consists mainly of seeds and grain for which they search the bare ground, weed patches, feed yards, stacks, and stables, but in spring and summer their crops and stomachs are found well filled with both seeds and insects from the edges of the melting snowbanks, where they are generally found feeding. Miller says a number of specimens collected near their breeding grounds were exceedingly fat and had their throats and gullets crammed with moisture-softened seeds and bits of newly sprouted plants. Wetmore says they were first seen feeding on old snowbanks, picking up seeds and insects. What they feed the young, and what are their own choice foods throughout the year are still questions to be settled by more thorough study and close observation. Even the poor quality of their songs may be reported from insufficient observation or at a time of year when their full songs are not given, for they belong to a group of noted musicians. There is still much to be learned of these beautiful birds.

The three forms of rosy finches found in Yellowstone Park may be distinguished by the mainly black body of the black rosy

finch, the dark brown bodies of the gray-crowned and Hepburn's, while in the males. Hepburn's may be distinguished from the gray-crowned by the gray of the crown spreading down over the cheeks. The females and young are not so easily told apart.

Gray-crowned rosy finch. The known breeding range of these abundant but little known birds is in Arctic-Alpine Zone from Alaska, British Columbia, and Alberta south to Glacier Park, Montana, and the high mountains of California; but in winter they extend their range to Saskatchewan, Manitoba, western Nebraska, Colorado, New Mexico, and Utah. In Yellowstone Park they are regular winter residents in the low country and the commonest of the rosy finches found around the buildings, corrals, and stables at Mammoth Hot Springs, where they are seen as late as April 8. On March 10, 1916, on the Camp Roosevelt road around Crescent Hill, I found a flock of forty feeding on a bare clay bank on one side of the snow-blocked pass; but I have not been able to get late spring records in the park. On March 19, a flock of several hundred rosy finches was seen in Buffalo Horn Basin in West Gallatin Valley below the park line.

At Lewiston, Montana, Silloway²¹ says, by the middle of April the last of the gray-crowned have disappeared, but Mrs. Bailey and I found them around many of the high peaks of Glacier National Park in July and August. Just above Piegán Pass a pair of old birds were carrying food to their young in the cliffs above us and later we found young birds out of the nest.²²

In Jackson Valley, south of Yellowstone Park, they are common winter birds. Preble reported mixed flocks of several hundred along the Gros Ventre below Crystal Creek late in March; small flocks at Jackson, April 5 to 12; and large flocks as late as April 25 and 26.

²¹ Silloway, P. M., *Birds of Fergus County, Montana*, p. 40, 1903.

²² Bailey, Vernon and Florence Merriam, *Wild Animals of Glacier National Park*. Bull. National Park Service, p. 173, 1918.

These late dates strongly suggest a probable breeding range at no great distance, and it would not be surprising to find the birds breeding in the Teton and Absaroka mountains or around some of the other high peaks in or near the park. The importance of determining the species of any rosy finches found and especially of those breeding in the park region can not be too strongly urged.

The nest and eggs of the gray-crowned were discovered in 1910 by Milton S. Ray and his companions on Pyramid Peak, in the Sierra Nevada back of Lake Tahoe, California. The nest was placed well back under the broken slide rock and boulders only one hundred and fifty feet below the summit of the peak at ten thousand and twenty feet altitude and far above timberline. Other birds were seen carrying nesting material into openings under the rocks and still others to crevices in sheer cliffs that were entirely inaccessible.

The nest with its four almost fresh pure white eggs, taken June 22, was back about three feet under several large boulders in a depression of the ground so that it could not be photographed until brought out into the light. It was described as very compactly made of dry grass stems and roots with finer light-colored grass and a few feathers for lining. Sterling Bunnell found the birds common during the breeding season around the highest peaks of the Sierra Nevada from this point south to Mount Whitney, always well toward the summits in Arctic-Alpine Zone where they were evidently breeding; but the nests are not found without careful search in the high cliffs or rock slides, which accounts for their remaining so long unknown.

In voice and general habits there seems to be little difference in the different species of rosy finches. They have many little twittering notes and a plaintive call like that of the mountain bluebird, while out of the clouds and storm comes an occasional raucous call note that is penetrating and unmistakable. Sillo-way describes their nuptial songs, heard any time after the middle of January but increasing in musical quality on sunshiny days

late in February, as a pretty little trill or wheezy chant, sometimes with no more force than that of the grasshopper sparrow and again with greater force and more varied expression. It seems to be aimed at some coy female close by rather than broadcast at large for a general audience.

The food of these finches, while at times mainly seeds and grain, in summer also includes numerous insects found chilled on snowbanks or active on the moist ground and vegetation. In some cases the throats and gizzards are found full of moist seeds, and again packed with small insects; but our knowledge of the food habits is about as fragmentary as of their other habits and life history adaptations. Few birds offer a more thrilling field for careful study with some of the excitement of discovery and adventure included.

Hepburn's rosy finch. This slightly darker and grayer-headed subspecies of the gray-crowned rosy finch has a summer range around the high peaks of the Cascades of Washington and Oregon, and the Coast Ranges of British Columbia and Alaska; but in winter the birds migrate south and east to the eastern base of the Rocky Mountains where they are recorded in Yellowstone Park and Jackson Hole, in mixed flocks with the two other species. On November 29, 1926, in the mountains of New Mexico, J. Stokeley Ligon collected specimens of the three forms from one flock with a single charge of fine shot.

In breeding and other habits the Hepburn's rosy finches are apparently very similar to those of the gray-crowned of which they are merely a northwestern geographic race. Only in winter will they be of interest in the Yellowstone Park region, but care should be used in discriminating the various forms in making field notes. The colored plate of the three forms by Olaus J. Murie is intended to make identification easy.

Of the great family of finches and sparrows the *redpoll*, *Alaska longspur*, *snow bunting*, and *tree sparrow* are winter visitors from the far north; while among the common summer breeders and singers are the *white-crowned sparrow*, *western*

vesper sparrow, *mountain song sparrow*, *pink-sided junco*, and *western chipping sparrow*. These may be found all summer over most of the park plateau, singing, nesting, and feeding young.

In the valley of the Yellowstone along the northern part of the park a few *western lark sparrows*, *Brewer's sparrows*, *lazuli buntings*, *spurred towhees*, and *green-tailed towhees* gather in the summer and occasionally or regularly breed in the low, open warm valleys.

The brilliantly yellow, red, and black *western or Louisiana tanager* is a common breeding bird over most of the park and one of the regular chorus of summer songsters, often singing close around the hotels and camps. This is one of the birds first discovered on the famous overland journey of Lewis and Clark, and dedicated to Louisiana, the great region which had just been acquired by the United States. At Old Faithful Camp a pair used to come to my doorstep every morning to pick up the few flakes of rolled oats that the woodchucks had failed to find.

Half a dozen kinds of swallows breed in the park and may be seen skimming over the meadows and water or coming to their nests in or under the eaves of buildings or in holes in banks or trees. The *cliff swallows* nest on canyon walls and cliffs or under the sheltering eaves of buildings, while the *tree swallows* and *northern violet-green* find old woodpecker holes in trees or cracks and crevices in log buildings for their nests. *Barn swallows* live around barns or bridges, and *bank swallows* and *rough-wings* dig holes in the banks of streams along the low valleys.

Warblers are not generally abundant as species or individuals in this high country but there are a few common species. *Audubon's warbler* breeds in the timber over much of the park and may be heard singing up to the time the young come out of the nest. *Macgillivray's warbler* and the *western yellow-throat* are heard in the marshy places all summer and evidently breed at the lower levels. The little black-capped *pileolated warbler* is fairly common in the Canadian Zone meadows. The *orange-crowned warbler* is common in July and probably breeds. The

Townsend's warbler has been reported breeding and there is one record of a *Calitroca warbler*, found dead in the poison gas of the Stygian Cave.

Pipits nest on the high peaks and ridges anywhere above timberline and are occasionally seen in Canadian Zone meadows below, just before or just after the short breeding season. They are most commonly seen on the ground and old boulders. Their dainty walk and tilting tails mark them anywhere.

Water ouzels are common all the year in the park, feeding and nesting along the rapid streams, singing in February and March, but rarely in summer. Skinner records their nests with eggs on Gardiner River as early as the middle of June, and I have found young in the nest on Two Ocean Pass as late as August 18.

Plain-colored streaked *sage thrashers* are often seen sitting on the tops of tall sage bushes in the open country where they breed and sing during the summer months. In general appearance they show relationship with the mocking birds but lack the white wing-patches. Their song is thrasherlike, full, rich, and rolling.

Cardinals occasionally come up the valley above Gardiner and even breed there, but are not found over the higher parts of the park.

A few *wrens*, *nuthatches*, *chickadees*, and *kinglets* fill niches in the forest bird life. The *ruby-crowned kinglet* takes a high place in the bird chorus, and its loud rich song from the spruce tops suggests a bird many times its tiny size.

The *Townsend's solitaire* breeds and sings over the park and a few even spend the winter among the sweet-berried juniper trees of the Gardiner and Yellowstone river valleys. Their songs when heard from the tip of some slender spruce spire fairly ring out over the landscape. Few birds can equal them as musicians.

The *willow thrush*, the *olive-backed*, and the *Audubon's hermit thrush* add their music to the bird chorus of summer but the

olive-backed and hermit are most surely heard in the early morning or in the evening. You must go to their particular woods and not expect them to come to you unless you are camping somewhat away from the crowds. The thrushes are shy birds more often heard than seen, but worth going far to hear.

Western robins are abundant, friendly and cheerful neighbors throughout the park, breeding in or around buildings, gathering food on the hotel lawns, or in blueberry time collecting in the woods in great numbers to feast on the little red blueberries under the trees.

Skinner reports a single *varied thrush* in immature plumage drinking at a water trough near the barns back of Old Faithful Inn on September 5, 1926. This is the first record for the park, and probably an extension of breeding range (Condor, p. 204, 1927).

Among the commonest, friendliest, and best-loved birds of the park are the *mountain bluebirds*, nesting in hollow trees or under the shelter of broad hotel piazzas, warbling their soft, rich song from telephone wires or fence posts and catching insects for the hungry young in the nests. The light greenish blue of both back and breast at once distinguishes them from the eastern or western blue birds, but their voices and habits are not very different.

LIST OF BIRDS OF YELLOWSTONE PARK

The following list of birds has been compiled from my notes for 1894, 1909, 1915, 1916, 1917, and 1926; from notes of B. H. Dutcher in 1894; Merritt Cary, Alexander Wetmore, and Clarence Birdseye in 1910; from H. C. Oberholser in 1927; from published lists and notes by M. P. Skinner in 1923, 1925, and 1929; and from *Yellowstone Nature Notes* of 1924 to 1928.

The term "resident" is here used for the species, not for the individual, as bird-banding investigations may well prove that many supposedly resident individuals have migrated from the north, replacing others that have gone farther south.

GREBES

Western Grebe: *Aechmophorus occidentalis*. Rare transient.

Holbæll's Grebe: *Colymbus grisegena holbællii*. Rare transient.

American Eared Grebe: *Colymbus nigricollis californicus*. Common.
Breeds in many lakes and ponds.

Pied-billed Grebe: *Podilymbus podiceps podiceps*. Migrant and occasional summer resident.

LOONS

Lesser Loon: *Gavia immer elasson*. Occasional summer resident.

GULLS AND TERNS

American Herring Gull: *Larus argentatus smithsonianus*. Three seen on Lewis Lake, August 24, 1927, by H. C. Oberholser.

California Gull: *Larus californicus*. The commonest gull on Yellowstone and other large lakes. Breeds on islands.

Ring-billed Gull: *Larus delawarensis*. A few on Yellowstone Lake in summer.

Bonaparte's Gull: *Larus philadelphia*. A rare migrant.

American Caspian Tern: *Hydroprogne caspia imperator*. A few breed on Molly Island in Yellowstone Lake.

American Black Tern: *Hydrochelidon nigra surinamensis*. A few seen over marshes and lakes in summer.

CORMORANTS

Double-crested Cormorant: *Phalacrocorax auritus auritus*. One record by M. P. Skinner (Condor, vol. 31, p. 128, 1929) of its nesting on Molly Island in Yellowstone Lake.

PELICANS

White Pelican: *Pelecanus erythrorhynchos*. Abundant. Breeding on Molly Island in Yellowstone Lake.

DUCKS, GEESE, AND SWANS

American Merganser; Sheldrake: *Mergus merganser americanus*.
Abundant on lakes and rivers. Breeds abundantly.

Red-breasted Merganser: *Mergus serrator*. Occasional migrant.

Hooded Merganser: *Lophodytes cucullatus*. Reported.

Mallard: *Anas platyrhynchos platyrhynchos*. Abundant over park.
Breeds in large numbers.

Gadwall: *Chaulelasmus streperus*. Common summer resident. Breeds in considerable numbers.

- Baldpate, American Widgeon: *Mareca americana*. Common migrant.
Rare in summer.
- Blue-winged Teal: *Querquedula discors*. Common all over park. Breeds.
- Cinnamon Teal: *Querquedula cyanoptera*. Occasional migrant. Rare in summer.
- Green-winged teal: *Nettion carolinense*. Common summer resident. Breeds.
- Shoveller: *Spatula clypeata*. Occasional migrant or summer resident.
- American Pintail: *Dafila acuta tzitziboa*. Occasional migrant or summer resident.
- Wood Duck: *Aix sponsa*. Reported as a rare summer resident.
- Redhead: *Nyroca americana*. Occasional migrant.
- Canvas-back: *Nyroca valisineria*. Occasional migrant.
- Greater Scaup Duck: *Nyroca marila nearctica*. Occasional migrant.
- Lesser Scaup Duck: *Nyroca affinis*. Breeds sparingly.
- American Golden-eye: *Glaucionetta clangula americana*. Common in winter.
- Barrow's Golden-eye: *Glaucionetta islandica*. Common in summer and breeding.
- Bufflehead: *Charitonetta albeola*. Common spring and fall migrant on deep lakes.
- Pacific Harlequin: *Histrionicus histrionicus pacificus*. Rare in summer. Probably breeds.
- American Scoter: *Oidemia americana*. Reported as rare visitor to Yellowstone Lake.
- White-winged Scoter: *Melanitta deglandi*. Reported as rare visitor to Yellowstone Lake.
- Ruddy Duck: *Erismatura jamaicensis rubida*. Summer resident, breeds in ponds.
- Lesser Snow Goose: *Chen hyperborea hyperborea*. Rare migrant.
- Canada Goose: *Branta canadensis canadensis*. Common resident. Skinner estimates four hundred pairs breeding in the park.²³
- Hutchins's Goose: *Branta canadensis hutchinsii*. A rare migrant.
- Whistling Swan: *Cygnus columbianus*. Common fall migrant.
- Trumpeter Swan: *Cygnus buccinator*. A few pairs breeding each year.

IBISES AND HERONS

- White-faced Glossy Ibis: *Plegadis guarauna*. Reported.
- Wood Ibis: *Mycteria americana*. One recorded in a marsh near the canyon (Nature Notes, vol. 2, no. 4, p. 6).

²³ Roosevelt Wild Life Bull., vol. 3, no. 1, p. 98, 1925.

Treganza's Great Blue Heron: *Ardea herodias treganzai*. Occasionally seen along streams and shores.

Black-crowned Night Heron: *Nycticorax nycticorax naevius*. One record for the park.

CRANES

Whooping Crane: *Grus americana*. One old record.

Western Sandhill Crane: *Grus canadensis tabida*. A few remain in the park every summer to breed.

Little Brown Crane: *Grus canadensis canadensis*. Reported as rare.

RAILS AND COOTS

Sora Rail: *Porzana carolina*. Summer resident but rarely seen.

American Coot. *Fulica americana americana*. Common summer resident.

Wilson's Phalarope: *Steganopus tricolor*. Apparently breeds in some of the lower marshes.

Northern Phalarope: *Lobipes lobatus*. Rare fall migrant.

AVOCETS

American Avocet: *Recurvirostra americana*. A rare summer visitor.

SNIPES, SANDPIPERS, AND CURLEW

Wilson's snipe: *Capella gallinago delicata*. Summer resident. Probably breeds.

Pectoral Sandpiper: *Pisobia maculata*. A rare migrant.

Baird's Sandpiper: *Pisobia bairdii*. A regular migrant in July and August.

Least Sandpiper: *Pisobia minutilla*. A regular late summer visitor.

Greater Yellow-legs: *Totanus melanoleucus*. A regular late summer visitor.

Lesser Yellow-legs: *Totanus flavipes*. A regular late summer visitor.

Western Solitary Sandpiper: *Tringa solitaria cinnamomea*. A regular late summer visitor.

Western Willet: *Catoptrophorus semipalmatus inornatus*. A regular late summer visitor.

Spotted Sandpiper: *Actitis macularia*. Abundant breeder along all streams and lake shores.

Long-billed Curlew: *Numenius americanus*. A rare migrant.

PLOVERS

Killdeer: *Oxyechus vociferus vociferus*. A common breeder over much of the park.

Black-bellied Plover: *Squatarola squatarola*. Reported by Skinner on Alum Creek, in September, 1926.

TURNSTONES

Ruddy Turnstone: *Arenaria interpres morinella*. Reported.

GROUSE

Richardson's Grouse: *Dendragapus obscurus richardsonii*. Common resident throughout the forest.

Franklin's Grouse: *Canachites franklinii*. Reported as very rare.

Gray Ruffed Grouse: *Bonasa umbellus umbelloides*. Common resident throughout the forest.

Columbian Sharp-tailed Grouse: *Pedioecetes phasianellus columbianus*. Reported as a rare resident.

Sage Grouse: *Centrocercus urophasianus*. Rare. Reported near Soda Butte in 1894.

Southern White-tailed Ptarmigan: *Lagopus leucurus altipetens*. Reported on Quadrant Mountain by Skinner in 1927.

DOVES

Western Mourning Dove: *Zenaidura macroura marginella*. Occasionally seen at the lower levels.

HAWKS AND EAGLES

Marsh Hawk: *Circus hudsonius*. Common all summer over marshes and open country.

Sharp-shinned Hawk: *Accipiter velox*. Common summer resident.

Cooper's Hawk: *Accipiter cooperii*. A few in summer and winter. Breeds.

Western Goshawk: *Astur atricapillus striatulus*. A few in summer and winter.

Western Red-tail: *Buteo borealis calurus*. Common. Breeds.

Swainson's Hawk: *Buteo swainsoni*. Common. Breeds.

Rough-legged Hawk: *Archibuteo lagopus sancti-johannis*. Regular winter visitor.

Ferruginous Rough-leg: *Archibuteo regalis*. Summer resident or visitor.

Golden Eagle: *Aquila chrysaetos*. Occasional resident or wanderer.

- Bald Eagle: *Haliaeetus leucocephalus leucocephalus*. Common. Breeds.
 Prairie Falcon: *Falco mexicanus*. Occasionally seen in summer.
 Duck Hawk: *Falco peregrinus anatum*. Breeds in lower part of Yellowstone Canyon.
 Pigeon Hawk: *Falco columbarius columbarius*. Occasionally seen in summer.
 Desert Sparrow Hawk: *Cerchneis sparveria phalaena*. Abundant summer resident.
 American Osprey: *Pandion haliaëtus carolinensis*. Abundant about Yellowstone Lake and Canyon. Breeding.

OWLS

- American Long-eared Owl: *Asio otus wilsonianus*. Reported as rare resident.
 Short-eared Owl: *Asio flammeus flammeus*. Occasional summer resident.
 Rocky Mountain Screech Owl: *Otus asio maxwelliae*. Common resident.
 Rocky Mountain Pygmy Owl: *Glaucidium gnoma pinicola*. Rare resident.
 American Hawk Owl: *Surnia ulula caparoch*. Reported as rare.
 Western Horned Owl: *Bubo virginianus occidentalis*. Common resident in timber and canyons.

KINGFISHERS

- Belted Kingfisher: *Streptoceryle alcyon alcyon*. Common summer resident. A few in winter.

WOODPECKERS

- Rocky Mountain Hairy Woodpecker: *Dryobates villosus monticola*. Common resident of the forests.
 Batchelder's Woodpecker: *Dryobates pubescens leucurus*. Common resident of the forests.
 Arctic Three-toed Woodpecker: *Picoides arcticus*. Rare resident and breeds.
 Alpine Three-toed Woodpecker: *Picoides americanus dorsalis*. Rare resident and breeds.
 Red-naped Sapsucker: *Sphyrapicus varius nuchalis*. Summer resident.
 Williamson's Sapsucker: *Sphyrapicus thyroideus nataliae*. Summer resident.

Western Red-headed Woodpecker: *Melanerpes erythrocephalus erythrophthalmus*. A few in summer in lower valleys.

Lewis's Woodpecker: *Asyndesmus lewisi*. Rare summer visitor.

Red-shafter Flicker: *Colaptes cafer collaris*. Common summer resident.

NIGHTHAWKS

Pacific Nighthawk: *Chordeiles minor hesperis*. Common breeding bird.

SWIFTS

White-throated Swift: *Aeronautes saxatalis*. Rare summer visitor.

HUMMINGBIRDS

Broad-tailed Hummingbird: *Selasphorus platycercus*. Summer visitor.

Rufous Hummingbird: *Selasphorus rufus*. Summer visitor.

Calliope Hummingbird: *Stellula calliope*. Common summer resident.

FLYCATCHERS

Kingbird: *Tyrannus tyrannus*. Occasional summer resident.

Arkansas Kingbird: *Tyrannus verticalis*. Rare summer resident.

Say's Phoebe: *Sayornis sayus sayus*. Occasional summer resident.

Western Olive-sided Flycatcher: *Nuttallornis borealis majorinus*. Common summer resident.

Western Wood Pewee: *Myiochanes richardsonii richardsonii*. Common summer resident at lower altitudes.

Western Flycatcher: *Empidonax difficilis difficilis*. Reported.

Little Flycatcher: *Empidonax traillii brewsteri*. Rare summer resident.

Hammond's Flycatcher: *Empidonax hammondii*. Rare summer resident.

Wright's Flycatcher: *Empidonax wrightii*. Common summer resident.

HORNED LARKS

Pallid Horned Lark: *Otocoris alpestris arcticola*. Reported in winter.

Hoyt's Horned Lark: *Otocoris alpestris hoyti*. Winter visitor.

Desert Horned Lark: *Otocoris alpestris leucolaema*. Common summer resident.

MAGPIES, JAYS, RAVENS, AND CROWS

American Magpie: *Pica pica hudsonia*. Common winter resident. A few in summer.

- Black-headed Jay: *Cyanocitta stelleri annectens*. Scarce resident.
 Rocky Mountain Jay: *Perisoreus canadensis capitalis*. Common resident.
 Mexican Raven: *Corvus corax sinuatus*. Common resident.
 Western Crow: *Corvus brachyrhynchos hesperis*. Common summer resident.
 Clark's Nutcracker: *Nucifraga columbiana*. Common resident.
 Pinyon Jay: *Cyanocephalus cyanocephalus*. Rare visitor.

BLACKBIRDS AND ORIOLES

- Bobolink: *Dolichonyx oryzivorus*. A few records.
 Sagebrush Cowbird: *Molothrus ater artemisiae*. Common summer resident. Young noted.
 Yellow-headed Blackbird: *Xanthocephalus xanthocephalus*. Local summer resident.
 Thick-billed Redwing: *Agelaius phoeniceus fortis*. Summer resident.
 Brewer's Blackbird: *Euphagus cyanocephalus cyanocephalus*. Abundant summer resident.
 Western Meadowlark: *Sturnella neglecta neglecta*. Common summer resident.
 Bullock's Oriole: *Icterus bullockii bullockii*. Rare summer resident at lowest levels.

FINCHES AND SPARROWS

- Rocky Mountain Evening Grosbeak: *Hesperiphona vespertina warreni*. Rare and irregular in summer.
 Rocky Mountain Pine Grosbeak: *Pinicola enucleator montana*. A rather rare resident.
 Cassin's Purple Finch: *Carpodacus cassinii*. Common resident.
 Bendire's Crossbill: *Loxia curvirostra bendirei*. Common resident.
 White-winged Crossbill: *Loxia leucoptera*. Rare visitor.
 Gray-crowned Rosy Finch: *Leucosticte tephrocotis tephrocotis*. Common winter resident reported in Jackson Hole up to April 26, 1911 (Preble).
 Hepburn's Rosy Finch: *Leucosticte tephrocotis littoralis*. Common winter resident.
 Black Rosy Finch: *Leucosticte atrata*. Occasional winter resident. Breeding on Needle Peak, Wyoming, July 10, 1910 (Cary).
 Redpoll: *Acanthis linaria linaria*. Winter visitor from the far north.
 Pale Goldfinch: *Astragalinus tristis pallidus*. Summer resident at low altitudes.

- Pine Siskin: *Spinus pinus pinus*. Common summer resident in Canadian Zone.
- English Sparrow: *Passer domesticus domesticus*. Common at Gardiner and Mammoth.
- Snow Bunting: *Plectrophenax nivalis nivalis*. Winter visitor from far north.
- Alaska Longspur: *Calcarius lapponicus alascensis*. Winter visitor from far north.
- Western Vesper Sparrow: *Pooecetes gramineus confinis*. Abundant summer resident.
- Western Savannah Sparrow: *Passerculus sandwichensis nevadensis*. Common summer resident.
- Western Lark Sparrow: *Chondestes grammacus strigatus*. Rare summer visitor at lowest levels.
- White-crowned Sparrow: *Zonotrichia leucophrys*. Abundant summer resident.
- Gambel's Sparrow: *Zonotrichia gambelii*. Rare visitor.
- White-throated Sparrow: *Zonotrichia albicollis*. Recorded as very rare.
- Western Tree Sparrow: *Spizella monticola ochracea*. Common winter visitor from far north.
- Western Chipping Sparrow: *Spizella passerina arizonae*. Abundant summer resident.
- Brewer's Sparrow: *Spizella breweri*. Common summer resident in sagebrush valleys.
- Shufeldt's Junco: *Junco oreganus shufeldti*. Rare migrant.
- Montana Junco: *Junco oreganus montanus*. Occasional migrant.
- Pink-sided Junco: *Junco mearnsi*. Abundant summer resident.
- Mountain Song Sparrow: *Melospiza melodia fallax*. Common summer resident.
- Lincoln's Sparrow: *Melospiza lincolnii lincolnii*. Common breeder in Canadian Zone.
- Slate-colored Fox Sparrow: *Passerella iliaca schistacea*. Rare summer resident.
- Spurred Towhee: *Pipilo maculatus montanus*. Common in summer at low altitudes.
- Green-tailed Towhee: *Oberholseria chlorura*. Common in summer at low altitudes.
- Black-headed Grosbeak: *Hedymeles melanocephalus papago*. Rare in spring migration.

Lazuli Bunting : *Passerina amoena*. Breeds in Yellowstone and Lamar river valleys at northern edge of park.

TANAGERS

Louisiana or Western Tanager: *Piranga ludoviciana*. Common summer resident.

SWALLOWS

Cliff Swallow: *Petrochelidon albifrons albifrons*. Common in summer. Breeds in colonies on cliffs and buildings.

Barn Swallow: *Hirundo erythrogaster*. Rare in summer.

Tree Swallow: *Iridoprocne bicolor*. Common summer resident.

Northern Violet-green Swallow: *Tachycineta thalassina lepida*. Common summer resident.

Bank Swallow: *Riparia riparia riparia*. Common in summer.

Rough-winged Swallow: *Stelgidopteryx serripennis serripennis*. Rare summer resident.

WAXWINGS

American Waxwing: *Bombycilla garrula pallidiceps*. Regular winter visitor.

Cedar Waxwing: *Bombycilla cedrorum*. Summer resident. Not common.

SHRIKES

Northern Shrike: *Lanius borealis*. Rare winter visitor.

White-rumped Shrike: *Lanius ludovicianus excubitorides*. Summer resident at low levels.

VIREOS

Western Warbling Vireo: *Vireosylva gilva swainsonii*. Common in summer.

WOOD WARBLERS

Calaveras Warbler: *Vermivora ruficapilla gutturalis*. Rare or accidental. One record.

Rocky Mountain Orange-crowned Warbler: *Vermivora celata oresteria*. Summer resident.

Western Yellow Warbler: *Dendroica aestiva morcomi*. Summer resident.

Hoover's Warbler: *Dendroica coronata hooveri*. Rare migrant.

Mountain Audubon's Warbler: *Dendroica auduboni memorabilis*. Common summer resident.

Townsend's Warbler: *Dendroica townsendi*. Summer resident.

Macgillivray's Warbler: *Oporornis tolmiei*. Summer resident in Transition Zone.

Western Yellow-throat: *Geothlypis trichas occidentalis*. Summer resident in Transition Zone.

Pileolated Warbler: *Wilsonia pusilla pileolata*. Common summer breeder in Canadian Zone.

PIPITS

American Pipit: *Anthus spinoletta rubescens*. Common breeder in Hudsonian Zone.

DIPPERS

American Dipper; Water Ouzel: *Cinclus mexicanus unicolor*. Common resident.

THRASHERS AND CATBIRDS

Sage Thrasher: *Oreoscoptes montanus*. Common summer resident in sagebrush of Transition Zone.

Catbird: *Dumetella carolinensis*. Summer resident in lowest valleys.

WRENS

Rock Wren: *Salpinctes obsoletus obsoletus*. Common in summer in low valleys and occasionally higher up.

Western House Wren: *Troglodytes ædon parkmanii*. Common in summer in Transition Zone.

Western Marsh Wren: *Telmatodytes palustris plesius*. Reported near Tower Falls.

CREEPERS

Rocky Mountain Creeper: *Certhia familiaris montana*. Summer resident in the forest.

NUTHATCHES

Rocky Mountain Nuthatch: *Sitta carolinensis nelsoni*. Resident, not common.

Red-breasted Nuthatch: *Sitta canadensis*. Common resident.

Rocky Mountain Pygmy Nuthatch: *Sitta pygæa melanotis*. A rare visitor.

TITMICE

Long-tailed Chickadee: *Penthestes atricapillus septentrionalis*. Resident along lower Yellowstone Valley.

Mountain Chickadee: *Penthestes gambeli gambeli*. Resident in Canadian Zone forest.

KINGLETS

Western Golden-crowned Kinglet: *Regulus regulus olivaceus*. Summer resident.

Ruby-crowned Kinglet: *Corthylio calendula calendula*. Summer resident.

THRUSHES, ROBINS AND BLUEBIRDS

Townsend's Solitaire: *Myadestes townsendi*. Summer resident.

Willow Thrush: *Hylocichla fuscescens salicicola*. Summer resident.

Olive-backed Thrush: *Hylocichla ustulata swainsoni*. Summer resident.

Audubon's Hermit Thrush: *Hylocichla guttata auduboni*. Summer resident.

Western Robin: *Turdus migratorius propinquus*. Common summer resident.

Western Bluebird: *Sialia mexicana occidentalis*. Rare migrant.

Mountain Bluebird: *Sialia currucoides*. Abundant summer resident.

CHAPTER V

FISH, REPTILES, AND AMPHIBIANS

FISH

THE BUREAU OF FISHERIES has listed three species of native food fishes in the park, the *cut-throat trout*, *mountain grayling*, and *Rocky Mountain whitefish*. To these have been added, by introduction in suitable streams or lakes, *rainbow trout*, *eastern brook trout*, *lake trout*, *European brown trout*, *Loch Leven trout*, and *yellow perch*. Several species of native suckers are found in some of the streams besides *dace*, *chubs*, *blobs*, and *silverside minnows*.

Modern fish hatcheries have been established at Mammoth Hot Springs, Soda Butte Creek, and at The Thumb on Yellowstone Lake, and every year the streams and lakes of the park are regularly stocked with fish to support the great amount of fishing done by visitors during the open season. In many places excellent fishing is to be found by those attracted by the sport and a large amount of good food is thus obtained by campers and tourists. The food fishes of the park are well known and under excellent control and management.

The so-called non-food fishes, the suckers, dace, chubs, and minnows, have received less attention but in some cases may prove to be of no less value as food for the native bird and animal life, especially such as the kingfishers, herons, gulls, terns, cormorants, pelicans, and numerous fish-eating ducks, as well as otters and minks. Also there is a close interrelationship between the fishes that we value and those that afford food for them or destroy the eggs and spawn of other more valuable species.

As with the mammals and birds, the study of fishes has been well begun. There is a most interesting account of them in Document No. 904 of the Bureau of Fisheries on *Fishes of the Yellowstone National Park* by Hugh M. Smith and William C. Kendall. This can be purchased at the Park Information Office at Mammoth Hot Springs or of Superintendent of Documents, Washington, D.C., for five cents, and should accompany every fisherman.

REPTILES AND AMPHIBIANS

In *Yellowstone Nature Book*, Skinner has given a list of three harmless snakes, a lizard, a pond turtle, a common toad, a tree frog, two green frogs, and a salamander. This is the best list available and goes far to show how meager the study of such small life has been. A few recent additions to the list have been made. A rubber snake added by Miss Herma Albertson near Old Faithful, in *Nature Notes* for September 1, 1928, extends the known range of the genus. Many other additions may be expected in the future from local or visiting naturalists.

The importance of such small life is rarely appreciated, either for its influence on still lower forms of life or its value as a food supply for higher forms or even to man. In many places the common marsh frogs are so abundant that if a person were lost a good meal could be procured in a short time with only a stick, a match, and a little salt. In fact many a good lunch has been made from toasted frogs' legs without salt, and with the addition of wild onions, camas, or thistle roots, a wholesome meal is easily obtained. Half a dozen edible bulbs and tubers and a few berries are generally available for food in the park. To illustrate the importance of reliable knowledge on such matters, we may mention that recently one of the park rangers was killed by eating the roots of poison parsnips or water hemlock, mistaken for a harmless species of the same family.

CHAPTER VI

INVERTEBRATES

INSECT LIFE in the park has been much neglected as a study but Skinner²⁴ lists one hundred and seventy-three species that have been collected and identified. These include some of the important parasites of birds and mammals and many of what we generally consider harmful, as well as useful species. He does not, however, include the biting flies and mosquitoes, which at certain seasons are troublesome to many of the game animals and have an important influence on their distribution and local migrations.

The value of insects as food for fish, birds, and even for many of the mammals has never been fully balanced against their destruction of vegetation, forests, and crops, or their annoyance of animals and man. Much remains to be learned of insect life in an outdoor laboratory of such magnitude as is offered by the park.

Other forms of invertebrate life, not included with the insects, such as crustaceans, mollusks, myriapods, spiders, ticks, mites, and still lower forms of life, have been given little study here, although some of the species are of great importance in the animal economy of the region, some as food for valuable species of birds, mammals, and fishes, others as dangerous and destructive parasites of game or other animals.

Our type of civilization has reached a stage where our own best welfare as well as our intellectual enjoyment of life depend largely upon a fuller knowledge of our total environment. In our national parks, we have the opportunity to add immeasurably to this knowledge.

²⁴ Yellowstone Nature Book, chapter 11, pp. 139-156, 1924.

INDEX

A

Acanthis linaria linaria, 224
Accipiter cooperii, 221
 velox, 221
 Acknowledgements, 7
Actitis macularia, 220
Aechmophorus occidentalis, 218
Aeronautes saxatalis, 223
Agelaius phoeniceus fortis, 224
Aix sponsa, 219
 Alaska longspur, 213, 225
Alces americanus shirasi, 36-42
 Alder, 11, 12
 American antelope, 29-36
 avocet, 220
 black tern, 218
 buffalo, 16-24
 Caspian tern, 218
 coot, 220
 dipper, 227
 eared grebe, 218
 elk, 42-60
 goldeneye, 192, 219
 hawk owl, 222
 herring gull, 218
 long-eared owl, 222
 magpie, 223
 American merganser, 192, 218
 osprey, 222
 pintail, 219
 pipit, 227
 scoter, 219
 waxwing, 226
 widgeon, 219
 Amphibians, 230
Anas platyrhynchos platyrhynchos, 218
 Antelope, American, 12, 29-36
 prong-horned, 29-36
Anthus spinoletta rubescens, 227
Antilocapra americana americana, 29-36
Aquila chrysaetos, 221
Archibuteo lagopus sancti-johannis, 221
 regalis, 221
Ardea herodias treganzai, 220
Arenaria interpres morinella, 221
Artemisia, 35
Asio flammeus flammeus, 222
 otus wilsonianus, 222

Aspen, 12, 56
 Asters, 56
Astragalinus tristis pallidus, 224
Astur atricapillus striatulus, 221
Asyndesmus lewisi, 223
 Atriplex, 56
 Avocet, American, 220

B

Badger, 151-153
 Baldpate, 219
 Balsam root, 11, 56
Balsamorhiza sagittata, 76
 Bat, hoary, 186-187
 large-brown, 185-186
 long-eared, 180-182
 silver-haired, 185
 Yellowstone, 12, 182-185
 Bear, black, 153-165
 cinnamon, 153-165
 grizzly, 13
 Bearberry, 56
 Beaver, Missouri River, 111-115
 Pacific, 111
 Belted kingfisher, 222
 Bendire's crossbill, 13, 224
 Bighorn, Rocky Mountain, 24-29
 Birch, dwarf, 12
 western, 11, 56
 Bison, 16-24
 bison bison, 16-24
 Bitterroot, 11
 little, 14
 Blackbird, Brewer's, 12, 207, 224
 yellow-headed, 207, 224
 Blob, 229
 Blueberry, dwarf, 12
 red, 12
 Bluebird, mountain, 217, 227
 western, 228
 Bobcat, Rocky Mountain, 132-135
 Wyoming, 12
 Bobolink, 224
Bombicilla cedrorum, 226
 garrula pallidiceps, 226
Bonasa umbellus umbelloides, 221
Branta canadensis canadensis, 219
 canadensis hutchinsii, 219

Bubo virginianus occidentalis, 222
 Buffalo, American, 12, 16-24
 wolf, 135-137
 Bufflehead, 219
 Bunting, Lazuli, 215, 226
 snow, 214, 225
Buteo borealis calurus, 221
 swainsoni, 221

C

Calcarius lapponicus alascensis, 225
Callospermophilus lateralis cinerascens, 83-85
Canachites franklinii, 221
 Canadian buffalo-berry, 64
Canis latrans nebracensis, 137-141
 lycaon nubilus, 135-137
 Canvas-back, 219
Capella gallinago delicata, 220
Carpodacus cassinii, 224
 Carrot, wild, 56
 Caspian tern, 191
Castor canadensis missouriensis, 111-115
 canadensis pacificus, 111
 Catbird, 12, 216, 227
Catoptrophorus semipalmatus inornatus, 220
 Cedar, red, 11, 56
 waxwing, 225
Centrocercus urophasianus, 221
Cerchneis sparveria phalaena, 222
Certhia familiaris montana, 227
Cervus canadensis canadensis, 42-60
Charitonetta albeola, 219
Chaulelasmus streperus, 218
Chen hyperborea hyperborea, 219
 Chickadee, 216
 long-tailed, 227
 mountain, 13, 227
 Chipmunk, large-tailed, 80
 little gray, 82-83
 little sagebrush, 12
 sagebrush, 82
 Uinta, 80
 Wasatch, 80-82
 yellow-bellied, 13, 77-80
 Chokecherry, 11
Chondestes grammacus strigatus, 225
Chordeiles minor hesperis, 223
 Chub, 229
Cinclus mexicanus unicolor, 227
 Cinquefoil, 11
 shrubby, 56
Circus hudsonius, 221
Citellus armatus, 85-89
 richardsonii richardsonii, 89
Clethrionomys, 103
 Clover, 56
 dwarf, 14
Colaptes cafer collaris, 223
Colymbus grisegena holboellii, 218
 nigricollis californicus, 218
 Compass plant, 76
 Cony, rock, 121-124
 Coot, 195
 American, 220
 Cormorant, double-crested, 218
Corthylia calendula calendula, 228
Corvus brachyrhynchos hesperis, 224
 corax sinuatus, 224
Corynorhinus macrotis pallescens, 180-182
 Cottontail, Rocky Mountain, 124-125
 Cottonwood, 56
 narrow-leaved, 11
 Cowbird, 207
 sagebrush, 224
 Cow parsnip, 56
 Cowslip, mountain, 14
 Coyote, 137-141
 Crane, little brown, 220
 sandhill, 190
 western sandhill, 220
 whooping, 191, 219
 Creeper, Rocky Mountain, 13, 227
 Crossbill, 208
 Bendire's, 13, 224
 white-winged, 224
 Crow, western, 12, 205, 224
 Curlew, long-billed, 220
 Currant, 56
 blue, 12
 black, 12
 red, 12, 14
 wild, 11
Cyanocephalus cyanocephalus, 224
Cyanocitta stelleri annectens, 224

Cygnus buccinator, 219
columbianus, 219

Cynomys ludovicianus ludovicianus,
 89-90

D

Dabchick, 192

Dace, 229

Dafila acuta tzitzihua, 219

Deer, 12

plains white-tailed, 12, 65-70

Rocky Mountain mule, 13, 60-65

Dendragapus obscurus richardsonii,
 221

Dendroica aestiva morcomi, 226

auduboni memorabilis, 226

coronata hooveri, 226

townsendi, 226

Dipper, American, 227

Dogtooth lily, 56

Dolichonyx oryzivorus, 224

Double-crested cormorant, 218

Dove, western mourning, 221

Dryobates pubescens leucurus, 222

villosus monticola, 222

Duck, greater scaup, 219

lesser scaup, 219

Pacific Harlequin, 219

ruddy, 219

wood, 219

Dumetella carolinensis, 227

E

Eagle, bald, 199, 222

golden, 199, 221

Elderberry, red, 13

Elk, American, 12, 13, 14, 42-60

Empidonax hammondi, 223

traillii brewsteri, 224

wrightii, 223

Eptesicus fuscus fuscus, 185-186

Erethizon epixanthum epixanthum,
 115-117

Eriogonum, 56

Erismatura jamaicensis rubida, 219

Euarctos americanus cinnamomum,
 153-165

Euphagus cyanocephalus cyanocephalus,
 224

Eurotia, 35

Eutamias amoenus luteiventris, 77-80

minimus clarus, 82-83

minimus consobrinus, 80-82

Eutamias pictus, 82

umbrinus, 80

Evotomys gapperi galei, 103

F

Falco columbarius columbarius, 222

mexicanus, 222

peregrinus anatum, 222

Falcon, prairie, 199, 222

Felis concolor hipolestes, 129-131

Finch, Cassin's purple, 208, 224

Fir, 56

alpine, 12

dwarf alpine, 14

Fireweed, 56

Fish, 229-230

Fisher, 148

Flax, wild, 11

Flicker, red-shafted, 204, 223

Fly honeysuckle, 56

Flycatcher, Hammond's, 223

olive-sided, 13

western, 223

western olive-sided, 223

Wright's, 204, 223

Forget-me-not, 14

Fox, mountain red, 141-142

Frog, green, 230

tree, 230

Fulca americana americana, 220

G

Gadwall, 194, 218

Gavia immer, 218

Geothlypis trichas occidentalis, 227

Geranium, 11, 56

Glaucidium gnoma pinicola, 222

Glaucionetta clangula americana, 219
islandica, 219

Glaucomys sabrinus bangsi, 70-71

Globe flower, 14

Goldeneye, American, 192, 219

Barrow's, 192

Golden-mantled marmot, 90-95

Goldenrod, 11

Golden sage, 10

Golden woodchuck, 13

Goldfinch, pale, 224

- Goose, Canada, 188, 214
 Hutchins's, 219
 lesser snow, 214
 Gooseberry, 11, 56
 Goshawk, western, 200, 221
 Grass, wild meadow, 56
 Grasses, 56
 Gravel, 10, 56
 Graveling, mountain, 214
 Greasewood, 11
 Great blue heron, 214
 Grebe, American eared, 162, 218
 Humboldt's, 218
 pied-billed, 218
 small, 218
 western, 141, 218
 Grizzly bear, 13
 small, Yellowstone Park, 174-175
 Yellowstone Park, 185-175
 Grosbeak, black-headed, 208, 225
 Rocky Mountain evening, 207, 224
 Rocky Mountain pine, 13, 14, 208, 224
 Ground squirrel, gray mantled, 16, 83
 Richardson's, 83
 Utah, 11, 85
 Grizzly, Canadian sharp-shinned, 10
 194, 221
 Grizzly, 13, 14, 221
 gray ruffed, 194, 221
 Richardson's, 13, 148, 201
 Utah, 11, 85, 201
 Grus americana, 214
 canadensis canadensis, 214
 canadensis turana, 214
 Gull, American herring, 218
 Bonaparte's, 218
 Canada, 191, 218
 ring-billed, 191, 218
 Gull, Iceland, 188-189
 Gull, 14
 H
 Halcyon leucocephalus leucocephalus, 221
 Hare, pine, 117-120
 Hawk, Cooper's, 200, 221
 lesser sharp-shinned, 200, 221
 Jack, 200, 221
 rufuginous rough-legged, 200, 221
 marsh, 201, 221
 pigeon, 222
 rough-legged, 221
 sharp-shinned, 201, 221
 Swainson's, 200, 221
 Hawkweed, 11
 Heather, mountain, 14
 Hedymeles melanocephalus papago, 225
 Hell-diver, 192
 Heron, black-crowned night, 220
 Heron, Treganza's great blue, 194, 220
 Hesperiphona vespertina warreni, 224
 Hirundo erythrogaster, 226
 Histrionicus histrionicus pacificus, 219
 Honeysuckle, fly, 13, 56
 red-berried, 13
 wild, 41
 Huckleberry, 56
 Hummingbird, broad-tailed, 204, 223
 calliope, 204, 223
 rufous, 204, 223
 Hydrochelidon nigra surinamensis, 218
 Hylodichla guttata auduboni, 228
 ustulata swainsoni, 228
 Hydroprogne caspia imperator, 218
 I
 Ibis, white-faced glossy, 219
 wood, 219
 Icterus bullockii bullockii, 224
 Invertebrates, 231
 Iridoprocne bicolor, 226
 J
 Jacob's ladder, 14
 Jay, black-headed, 13, 205, 224
 Canada, 206
 pinyon, 206, 224
 Jay, Rocky Mountain, 13, 14, 224
 Junco, 14
 mearnsi, 225
 Montana, 225
 oreganus montanus, 225
 oreganus shufeldti, 225
 pink-sided, 13, 215, 225
 Shufeldt's, 225
 Juniper, 98
 shrubby, 12

K

- Killdeer, 195, 221
 Kingbird, 12, 223
 Arkansas, 205, 223
 eastern, 205
 Kingfisher, 201
 belted, 222
 Kinglet, 14, 216
 ashy ruby-crowned 13, 216, 228
 western golden-crowned, 13, 228

L

- Lagopus leucurus alpitertens, 221
 Lanius borealis, 226
 ludovicianus excubitorides, 226
 Lark, desert horned, 205, 223
 Hoyt's horned, 223
 pallid horned, 223
 Larkspur, 11, 56
 subalpine, 14
 Larus argentatus smithsonianus, 218
 californicus, 218
 delawarensis, 218
 philadelphia, 218
 Lasionycteris noctivagans, 185
 Laurel, mountain, 14
 Lepargyrea canadensis, 12, 64
 Lepus bairdii bairdii, 125-127
 townsendii campanius, 127-129
 Leucosticte atrata, 224
 tephrocotis littoralis, 224
 tephrocotis tephrocotis, 224
 Life zones, 9
 Arctic-Alpine, 14
 Canadian, 12
 Hudsonian, 13
 Transition, 11
 Upper Sonoran, 10
 Lily, dogtooth, 56
 Lion, mountain, 129-131
 Lizard, 230
 Lobipes lobatus, 220
 Loco, 11
 Longspur, Alaska, 214, 225
 Lonicera conjugialis, 41
 Loon, common, 191, 217
 Lophodytes cucullatus, 218
 Loxia curvirostra bendirei, 224
 leucoptera, 224

Lungwort, 56

- Lupine, 11, 56
 small-flowered, 14
 Lutra canadensis canadensis, 142-143
 Lynx, Canada, 132
 canadensis canadensis, 132
 uinta, 132-135

M

- Maggie, American, black-billed, 205, 223
 Mallard, 194, 218
 Maple, mountain, 56
 Mareca americana, 219
 Marmot, golden-mantled, 90-95
 Marmota flaviventris nosophora, 90-95
 Marten, 13
 Rocky Mountain, 147-148
 Martes caurina origines, 147-148
 pennanti pennanti, 148
 Meadowlark, western, 207, 224
 Melanerpes erythrocephalus erythrophthalmus, 223
 Melanitta deglandi, 219
 Melospiza lincolni lincolni, 225
 melodia fallax, 225
 Mephitis hudsonica, 149-151
 Merganser, American, 192, 218
 hooded, 192, 218
 red-breasted, 192, 218
 Mergus merganser americanus, 218
 serrator, 218
 Mexican raven, 224
 Microtus mordax mordax, 106-107
 nanus nanus, 104-106
 pennsylvanicus modestus, 103-104
 richardsoni macropus, 107
 Mink, 143-145
 Minnows, silverside, 229
 Molothrus ater artemisiae, 224
 Moose, Shira's, 13, 36-42
 Yellowstone, 36-42
 Mountain ash, 13
 Mountain sheep, 12, 24-29
 timothy, 55
 Mouse, Audubon's grasshopper, 101-102
 house, 101
 jumping, 13

- large-footed meadow, 107
 little mountain meadow, 104-106
 red-backed, 13, 103
 Rocky Mountain jumping, 117-119
 Rocky Mountain lemming, 13, 102-103
 Rocky Mountain meadow, 13, 106-107
 Saguache meadow, 103-104
 white-footed, 102
Mus musculus, 101
 Mushrooms, 56
 Muskrat, mountain, 108-111
 Mussels, 109
Mustela arizonensis arizonensis, 145-147
 cicognantii leptus, 147
 vison energumenos, 145-145
Myadestes townsendi, 228
Mycteria americana, 219
Myiochanes richardsonii richardsonii, 223
Myotis lucifugus carissima, 182-185
- N
- Neotoma cinerea cinerea*, 95-100
 cinerea orolestes, 100-101
Neritio carolinense, 219
 Nighthawk, Pacific, 204, 225
Nucifraga columbiana, 224
Numenius americanus, 220
 Nutcracker, Clark's, 13, 14, 206, 224
 Nuthatch, 216
 pygmy, 227
 red-breasted, 13, 227
 Rocky Mountain, 227
Nuttallornis borealis majorinus, 223
Nycteria cinerea, 186-187
Nycticorax nycticorax naevius, 220
Nyroca affinis, 219
 americana, 219
 marila nearctica, 219
 valisineria, 219
- O
- Oberholseria chlorura*, 225
Ochotona princeps ventorum, 121-124
Odocoileus hemionus macrotis, 60-65
 virginianus macrourus, 65-70
Ondemia americana, 219
Ondatra zibethica osorensis, 108-211
Onychomys leucogaster missouriensis, 101-102
Oporornis tolmiei, 227
Oreoscoptes montanus, 227
 Oriole, Bullock's, 224
 Osprey, American, 199, 209, 222
Orocorys alpestris arcticola, 223
 alpestris boyti, 223
 alpestris leucolaema, 223
 Otter, Canada, 142-145
Orus asio maxwelliae, 222
 Ousel, water, 216, 227
Ovis canadensis canadensis, 24-29
 Owl, 199
 American hawk, 222
 American long-eared, 222
 hawk, 201
 long-eared, 201
 Rocky Mountain pygmy, 201, 222
 Rocky Mountain screech, 201, 222
 short-eared, 201, 222
 western great horned, 201, 222
Oxyechus vociferus vociferus, 221
- P
- Paint brush, 11, 56
Pandion haliaetus carolinensis, 222
 Parsnip, cow, 56
Passer domesticus domesticus, 225
Passerculus sandwichensis nevadensis, 225
Passerella iliaca schistacea, 225
Passerina amoena, 226
Pedioecetes phasianellus columbianus, 221
Pelecanus erythrorhynchos, 218
 Pelican, white, 191, 218
Penthestes atricapillus septentrionalis, 227
 gambeli gambeli, 227
 Penstemon, 11
 Pench, yellow, 229
Perisoreus canadensis capitalis, 224
Peromyscus manicularus artemisiae, 102
Petrochelidon albifrons albifrons, 226
 Pewee, western wood, 205, 223

- Phalacrocorax auritus auritus*, 218
Phalarope, northern, 220
 Wilson's, 220
Phenacomys intermedius intermedius
 102-103
Phlox, dwarf, 14
Phoebe, Say's, 10, 205, 223
Pica pica hudsonia, 223
Picoides americanus dorsalis, 222
 arcticus, 222
Pika, Wyoming, 121-124
Pine, limber, 11, 56, 74, 98
 lodgepole, 12, 56
 white-barked, 13, 14
 yellow, 10
Pinicola enucleator montana, 224
Pintail, American, 219
Pinus albicaulis, 13, 74
 flexilis, 74
Pipilo maculatus montanus, 225
Pipit, American, 216, 227
Piranga ludoviciana, 226
Pisobia bairdii, 220
 maculata, 220
 minutilla, 220
Plectrophenax nivalis nivalis, 225
Plegadis guarauna, 219
Plover, black-bellied, 198, 221
Pocket gopher, brown, 119-121
Podilymbus podiceps podiceps, 218
Pondweed, 109
Pooecetes gramineus confinis, 225
Poplar, balsam, 12
Porcupine, yellow-haired, 13, 115-117
Porzana carolina, 220
Potentilla, 56
Prairie-dog, black-tailed, 89-90
Procyon lotor lotor, 153
Pronghorn, 29-36
Ptarmigan, southern white-tailed, 199,
 221
- Q
- Querquedula cyanoptera*, 219
 discors, 219
- R
- Rabbit*, 13
 cottontail, 10
 snowshoe, 125-127
 white-tailed jack, 12, 127-129
 Rabbit berry, 12
 Rabbitbrush, 35, 56
 Raccoon, 153
 Rail, sora, 195, 220
 Raspberry, 65
 Raven, Mexican, 205, 224
 Recurvirostra americana, 220
 Redhead, 219
 Redpoll, 214, 224
 Red-tail, western, 200, 221
 Redwing, thick-billed, 207, 224
 Regulus regulus olivaceus, 228
 Reptiles, 230
 Riparia riparia riparia, 226
 Robin, western, 217, 228
 Rose bush, 65
 Rose, wild, 11, 56
 Rosy finch, 208-214
 black, 15, 208-212, 224
 gray-crowned, 224
 Hepburn's, 224
 Rudbeckia, 56
- S
- Sage, golden, 10
 white, 10, 35, 56
 Sagebrush, 11, 35, 56, 82
 Saguache meadow mouse, 103-104
 Salamander, 230
 Salpinctes obsoletus obsoletus, 227
 Sandpiper, Baird's, 220
 least, 220
 pectoral, 220
 spotted, 195, 220
 western solitary, 220
 Sapsucker, red-naped, 13, 203, 222
 Williamson's, 203, 222
 Sayornis sayus sayus, 223
 Sciurus hudsonicus ventorum, 71-77
 Scoter, American, 219
 white-winged, 219
 Sedges, 56
 Selasphorus platycercus, 223
 rufus, 223
 Serviceberry, 11, 56
 Shadscale, spiny, 10
 Sheldrake, 192, 218
 Shooting star, small-flowered, 14
 Shoveller, 219
 Shrew, cinereous, 13, 177-178

- dusky, 13, 175-177
 masked, 177-178
 mountain water, 13, 178-180
 Rocky Mountain, 177
 Shrike, northern, 226
 white-rumped, 226
 Sialia currucoides, 227
 mexicana occidentalis, 228
 Silvertip, 165-173
 Siskin, pine, 13, 225
 Sitta canadensis, 227
 carolinensis nelsoni, 227
 pygmaea, 227
 Skunk, northern, 12, 149-151
 Snake, rubber, 230
 Snakebrush, 35
 Snipe, Wilson's, 198, 220
 Snowberry, 56
 Solitaire, Townsend's, 13, 216, 228
 Sorex cinereus cinereus, 177-178
 obscurus obscurus, 175-177
 palustris navigator, 178-180
 personatus, 177
 vagrans monticola, 177
 Sorrel, mountain, 14
 Sparrow, Brewer's, 215, 225
 English, 225
 Gambel's, 225
 Lincoln's, 13, 225
 mountain song, 214, 225
 slate-colored fox, 225
 tree, 214
 western chipping, 12, 215, 225
 western lark, 215, 225
 western savannah, 225
 western tree, 225
 western vesper, 12, 214, 225
 white-crowned, 13, 214, 225
 white-throated, 225
 Spatula clypeata, 219
 Sphyrapicus thyroideus nataliae, 222
 varius nuchalis, 222
 Pinus pinus, 225
 Spizella breweri, 225
 monticola ochracea, 225
 passerina arizonae, 225
 Spruce, 56
 blue, 12
 Douglas, 12, 56, 74, 98
 Englemann, 12, 14
 Squatarola squatarola, 221
 Squirrel, Bang's flying, 70-71
 gray-mantled ground, 83-85
 pine, 13
 red, 71-77
 Richardson's ground, 89
 Uinta ground, 85-89
 Wind River pine, 71-77
 Steganopus tricolor, 220
 Stelgidopteryx serripennis serripennis, 226
 Stellula calliope, 223
 Strawberry, wild, 56
 Streptoceryle alcyon alcyon, 222
 Sturnella neglecta neglecta, 224
 Suckers, 229
 Sunflower, wild, 56
 Surnia ulula caparoch, 222
 Swallow, bank, 215, 226
 barn, 215, 226
 cliff, 215, 226
 northern violet-green, 215, 226
 rough-winged, 215, 226
 tree, 215, 226
 Swan, trumpeter, 188, 219
 whistling, 219
 Swift, white-throated, 223
 Sylvilagus nuttalli grangeri, 124-125
- T
- Tachycineta thalassina lepida, 226
 Tanager, Louisiana, 215, 226
 western, 12, 215, 226
 Taxidea taxus taxus, 151-153
 Teal, blue-winged, 194, 219
 cinnamon, 219
 green-winged, 194, 219
 Telmatodytes palustris plesius, 227
 Tern, black, 218
 Caspian, 191, 218
 Tetradychia, 10
 Thimbleberry, 13
 Thistle, 56
 pink, 11
 Thomomys fuscus fuscus, 119-121
 Thrasher, sage, 12, 216, 227
 Thrush, Audubon's hermit, 13, 215, 228
 olive-backed, 13, 216

varied, 217
 willow, 216, 228
 Timothy, mountain, 55
 Toad, 230
 Totanus flavipes, 220
 melanoleucus, 220
 Towhee, green-tailed, 215, 225
 spurred, 215, 225
 Tringa solitaria cinnamomea, 220
 Troglodytes aedon parkmanii, 227
 Trout, cut-throat, 229
 eastern brook, 229
 European brown, 229
 lake, 229
 Loch Leven, 229
 rainbow, 229
 Turdus migratorius propinquus, 228
 Turnstone, ruddy, 221
 Turtle, pond, 230
 Tyrannus tyrannus, 223
 verticalis, 223

U

Ursus horribilis emperor, 165-173
 mirus, 173-175

V

Venus looking glass, 14
 Vermivora celata orestera, 226
 ruficapilla gutturalis, 226
 Vireo, western warbling, 12, 226
 Vireosylva gilva swainsonii, 226
 Vulpes fulvus macrourus, 141-142

W

Wapiti, 42-60
 Warbler, 14
 Audubon's, 13, 215
 Calaveras, 216, 226
 Hoover's, 226
 Macgillivray's, 215, 227
 mountain Audubon's, 226
 pileolated, 13, 215, 227
 Rocky Mountain orange-crowned,
 215, 226
 Townsend's, 216, 226
 western yellow, 226

Water lilies, 109
 Waxwing, American, 226
 cedar, 226
 Weasel, Arizona, 145-147
 dwarf, 147
 Whitefish, Rocky Mountain, 229
 Widgeon, American, 219
 Wild rye grass, 56
 Willet, western, 220
 Willow, 12, 56
 diamond, 11
 dwarf, 14
 Wilsonia pusilla pileolata, 227
 Wind flower, 11
 Wolf, buffalo, 135-137
 gray, 135-137
 Wolverine, 13, 148-149
 Woodchuck, golden, 13, 90-95
 Woodpecker, Alpine three-toed, 13,
 14, 202, 222
 Arctic three-toed, 13, 202, 222
 Batchelder's, 203, 222
 Lewis's, 12, 204, 223
 Rocky Mountain hairy, 202, 222
 western red-headed, 204, 223
 Wood rat, gray bushy-tailed, 12, 95-
 100
 Colorado bushy-tailed, 100-101
 Wren, 216
 rock, 227
 western house, 227
 western marsh, 227
 Wyethia, 11

X

Xanthocephalus xanthocephalus, 224

Y

Yellow-legs, greater, 220
 lesser, 220
 Yellow-throat, western, 12, 215, 227

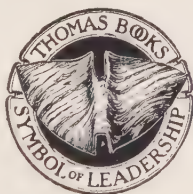
Z

Zapus princeps princeps, 117-119
 Zenaidura macroura marginella, 221
 Zonotrichia albicollis, 225
 gambelii, 225
 leucophrys, 225

THIS BOOK

ANIMAL LIFE OF YELLOWSTONE
NATIONAL PARK

was set, printed and bound by The Collegiate Press of Menasha, Wisconsin. The Cover Design is by The Decorative Designers of Chatham, New Jersey. The Type Face is Garamond. The type is set 12 on 13 Intertype. The type page is 24 x 40 picas. The end sheets are 25 x 38—80 White Antique Tuftex. The jacket is 20 x 26—60 Dragon Embossing. The insert paper is 25 x 38—100 White Lustro Enamel. The text paper is 38 x 50—140 (70 lb. basis) Ivory Polychrome Enamel. The binding is Holliston Waverly Colors 296 T Pattern.



With THOMAS BOOKS careful attention is given to all details of manufacturing and design. It is the Publisher's desire to present books that are satisfactory as to their physical qualities and artistic possibilities and appropriate for their particular use.

*THOMAS BOOKS will be true to those laws of quality
that assure a good name and good will.*



NHMRL0009494

